Universitat Autònoma de Barcelona

2017/2018

Nanobiotechnology

Code: 100933
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OT	4	0

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

Other comments on languages

Teachers can interact with students in Catalan, Spanish or English. All contributions submitted for evaluation in English language will produce a bonus. This bonus will multiply the numerical grade obtained by a factor between 1 (minimum) and 1.1 (maximum)

Teachers

Julia Lorenzo Rivera

Prerequisites

No specific requirements. Still, it is advisable that exchange students have succesfully completed already 2 full academic years at their originating institution. Most reference literature is in the English language, which is also used in the figures projected in theory classes. Furthermore, oral communication in English will be used when the student addresses the teacher in this language.

Objectives and Contextualisation

To provide students with an adequate perspective of materials used in nanobiotechnology, their major synthesis protocols and the main methodologies available to characterize them. Strategies to increase the biocompatibility of nanomaterials and to vectorialize their transport to cells and inside cells will be considered. Finally, toxicity related possible problems and characteristic examples of the applications of such nanomaterials in living systems will be analysed.

Skills

- Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
- Apply the criteria for evaluating biotechnological risks.

- Apply the principal techniques for the use of biological systems: recombinant DNA and cloning, cell cultures, manipulation of viruses, bacteria and animal and plant cells, immunological techniques, microscopy techniques, recombinant proteins and methods of separation and characterisation of biomolecules.
- Interpret experimental results and identify consistent and inconsistent elements.
- Learn new knowledge and techniques autonomously.
- Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
- Read specialised texts both in English and ones own language.
- Reason in a critical manner
- Search for and manage information from various sources.
- Search for, obtain and interpret information from the principal databases on biology, bibliography and patents and use basic bioinformatic tools.
- Think in an integrated manner and approach problems from different perspectives.
- Use analytical methodologies for assaying the biological activity of cellular components, especially enzymes, both in vitro and in vivo.
- Use ICT for communication, information searching, data processing and calculations.
- Use the fundamental principles of mathematics, physics and chemistry to understand, develop and evaluate a biotechnological process.
- Work individually and in teams

Learning outcomes

1. Apply knowledge of mathematics, physics and chemistry in order to understand the fundamental principles of nanotechnology.
2. Apply the specific regulations in place in nanotechnology laboratories.
3. Evaluate the risks specific to nanotechnology.
4. Explain fundamental physical principles and the advanced technical applications of microscopy that enable the study of individual biomolecules.
5. Explain the applications of emerging technologies, especially nanotechnology, to the field of biotechnology.
6. Interpret experimental results and identify consistent and inconsistent elements.
7. Know the contributions that nanotechnology can make to the analysis of biomolecules.
8. Learn new knowledge and techniques autonomously.
9. Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
10. Perceive the contributions that biotechnology has made to the construction of present-day nanotechnology.
11. Read specialised texts both in English and ones own language.
12. Reason in a critical manner
13. Search for and manage information from various sources.
14. Think in an integrated manner and approach problems from different perspectives.
15. Use and interpret information from useful databases in the field of nanotechnology.
16. Use ICT for communication, information searching, data processing and calculations.
17. Work individually and in teams

Content

Chapter 1. Introduction. Concept of Nano(bio)tecnology. Nanomaterials/nanoparticles/nanorobots. Nanometrology. Major methodologies for characterizing nanoparticles and nanomaterials. Nanofabrication. Interaction of nanomaterials with tissues.

Chapter 2. Major methodologies for characterization of nanoparticles and nanomaterials. Size, size range and concentration. Zeta potential. Electron Microscopy. Atomic force microscopy. Force spectrometry and cantilever sensors. Nanometrology and nanomanipulation. Optical tweezers. Other.

Chapter 3. Types of nanomaterials. Liposomes. Inorganic core nanoparticles. Organic core nanoparticles. Protein-based nanoparticles. Carbon-based nanotubes and graphene.

Chapter 4. Functionalization of nanomaterials to improve desired features: biocompatibility, substance transport, vectorialization, selective release (cell internalization, sub-cellular targeting), in vivo visualization of nanostructures, generation of biosensors and analytical nanodevices.

Chapter 5. Nanofabrication. Starting nanomaterials (nanoparticles, nanoplates, graphene-based materials). Nanofabrication: bulk (hard/top down), soft, atom by atom selective (pick and place).

Chapter 6. Aplications of Nano(bio)technology to: personalized medicine (diagnostic and therapy, tissue engineering, biodistribution, nanotoxicology). Other applications.

Methodology

Theory and guided problem-solving classes. Emphasis will be placed in the learning performance of students. Such learning performance will be actively fostered by teachers by providing gradings for the homework and problem solving tasks performed by students (see evaluation strategy section). Laboratory work (3 sessions) will be performed in 2-3 people groups.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Laboratory work	12	0.48	8, 16, 2, 13, 6, 11, 14, 12, 17, 15, 3
Problems based teaching	13	0.52	8, 1, 16, 13, 6, 11, 14, 12, 17, 15
Theory classes	26	1.04	1, 7, 4, 5, 11, 10, 3
Type: Supervised			
Homework delivery and associated interaction through "Campus Virtual"	14	0.56	8, 1, 16, 13, 7, 5, 9, 6, 11, 14, 10, 12, 17, 15
Tutor supervision	2	0.08	14, 12, 17
Type: Autonomous			
Information retrieval, study, processing of gathered information and electronic delivery of supervised homework through "Campus Virtual"	46.5	1.86	8, 1, 16, 13, 7, 4, 5, 9, 6, 11, 14, 10, 12, 17, 15
Solving problems	10	0.4	8, 1, 16, 13, 7, 6, 11, 14, 10, 12, 17, 15
Studying for exams	10	0.4	1, 7, 4, 5, 9, 6, 11, 14, 10, 12
Writing the laboratory work report	6	0.24	8, 16, 2, 13, 9, 6,

	11, 14, 12, 17, 15, 3

Evaluation

All contributions submitted for evaluation in English language will produce a bonus. This bonus will multiply the numerical grade obtained by a factor between 1 (minimum) and 1.1 (maximum).

- The percentage contribution to the global evaluation will be: 51% supervised participative homework and problem solving evaluation, 10% Laboratory work evaluation and delivery of the lab work report, 39 % partial exams.

- Exams: Written exams with short questions and/or problems to solve, with unlimited offline access to course related information. Internet access authorization during the exam may vary in different partial exams (ask each responsible teacher for details). The first partial will be after chapter 3, and the second one, after chapter 6. Final exam grade will be the mean of the two partial exams.

- Continuous work performance evaluation. There will be 2-3 homework reports to be delivered during the course. Such homework may be of the type of: problem solving, publication data interpretation, literature search, seminar delivery, etc. Every teacher in charge will propose the homework subject through the "Campus Virtual" interactive tools. In case written deliveries are requested, both electronic and printed submission within the allocated time frame will be mandatory. Homework may be individual or in small groups, according to the teacher instructions in each instance.

- Revision of grades. A revision date and time frame will be announced after each written partial exam. Furthermore, grades for other course work will appear periodically all along the course at the "Campus Virtual". There will be at least 3 time frames for revision offered during the course. Day and time frame for grade revision will be duly advertised at "Campus Virtual" at least 48 hours prior to the starting revision time, and also at class time.

- A student will be given the "not assessable" grade whenever: a) the global evaluation of all course activities performed would not allow the student to secure a "5" grade assuming he/she would have obtained maximal qualification in all of them or, b) the total number of grading activities undertaken does not reach the 50% level for the programmed course work to be evaluated.

- As for the grading strategy, all homework and supervised work handed in for evaluation will be considered individual items contributing the global evaluation section of the course (51% of the total grading).

- Students not able to attend an evaluation exam due to relevant conditions (illness, family death, accident) and deliver valid proof of such condition to the teacher/degree Coordinator, will be allowed to perform the missing evaluation at a different date. The degree coordinator will oversee this in case of need to secure an adequate date for performing the additional evaluation.

- To be able to attend the laboratory work sessions the student should provide proof of successful evaluation of lab security and biosecurity conditions available through "Campus Virtual". Furthermore, he/she should be aware and accept the rules for access and work at the laboratories of the Faculty of Biosciences.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Homework delivery	51%	6	0.24	8, 1, 13, 7, 4, 5, 9, 6, 11, 14, 10, 12, 17, 3
Laboratory work evaluation and delivery of the lab work report	10%	0.5	0.02	8, 1, 16, 2, 13, 9, 6, 11, 14, 12, 17, 15, 3

Partial exams	39%	4	0.16	13, 4, 5, 9, 6, 11, 14, 12, 3

Bibliography

Reference Books

1. Nanomedicine. An Introductory Textbook. Rob Burgess. Pan Stanford Publishing 2012.

2. Nanoparticles in translational science and medicine. Ed Antoni Villaverde, in "Progress in Molecular Biology and Translational Science and Medicine" Vol. 104, Elsevier, Amsterdam, 2011.

3. Nanobiotechnology. Eds. Christof Niemeyer and Chad Mirkin, 2004, Wiley-VCH.

4. Nanobiotechnology II. Eds. Chad Mirkin and Christof Niemeyer, 2007, Wiley-VCH.