

Nanobiotechnology

Code: 101922
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	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 successfully 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

- Contribute to public discussions on cultural matters.
- Develop independent learning habits and motivation to continue training at postgraduate level.
- Develop scientific knowledge, critical reasoning and creativity.
- Display knowledge of engineering methodologies in nanotechnology and electronics with the aim of applying them to biomedicine.
- Identify and understand the advances and challenges of research.

- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Show respect for the ethical and legal aspects of research and professional activities.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning outcomes

1. Contribute to public discussions on cultural matters.
2. Describe the basic principles of nanobiotechnology.
3. Develop independent learning habits and motivation to continue training at postgraduate level.
4. Develop scientific knowledge, critical reasoning and creativity.
5. Identify and understand the advances and challenges of research.
6. Read specialised texts both in English and ones own language
7. Search for and manage information from various sources
8. Show respect for the ethical and legal aspects of research and professional activities.
9. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

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

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	7, 1, 2, 4, 3, 5, 6, 9
Laboratory work evaluation and delivery of the lab work report	10%	0.5	0.02	7, 4, 3, 6, 9
Partial exams	39%	4	0.16	8, 7, 2, 4, 5, 6

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.