

Nanobiotechnology

Code: 101922
ECTS Credits: 6

| Degree | Type | Year | Semester |
|-----------------------------|------|------|----------|
| 2501230 Biomedical Sciences | 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: No
Some groups entirely in Spanish: No

Other comments on languages

Classroom practices and chapters 1 to 3 will be taught in 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

Carles Arús Caralto
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. Teaching for chapters 1 through 3, both for theory and problems, will be fully in English.

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.

Competences

- Display knowledge of engineering methodologies in nanotechnology and electronics with the aim of applying them to biomedicine.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Describe the basic principles of nanobiotechnology.
2. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
3. Read specialised texts both in English and ones own language
4. Search for and manage information from various sources
5. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
6. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
7. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
8. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
9. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
10. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

Chapter 1. (in English) Introduction. Concept of Nano(bio)technology.

Nanomaterials/nanoparticles/nanorobots. Nanometrology. Major methodologies for characterizing nanoparticles and nanomaterials. Nanofabrication. Interaction of nanomaterials with tissues.

Chapter 2. (in English) 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. (in English) 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, vectorization, 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. Applications of Nano(bio)technology to personalized medicine (diagnostic and therapy, tissue engineering, biodistribution, nanotoxicology). Other applications.

"*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

"*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents."

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.

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Activities

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

Assessment

All contributions submitted for evaluation in the 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: 50% supervised participative homework and problem-solving evaluation minimum of 3 different evaluation items, 10% Laboratory work evaluation and delivery of the lab work report, 40% partial exams (two).
- 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. The final exam grade will be the mean of the two partial exams.
- Continuous work performance evaluation. There will be a minimum of 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. 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.
- As for the grading strategy, all homework and supervised work handed in for an evaluation (3 items minimum) will be considered individual items contributing to the global evaluation section of the course (50% 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 a 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 of and accept the rules for access and work at the laboratories of the Faculty of Biosciences.
- Retake process description. To be eventually eligible for the application of the retake process for final grading, the student should have been evaluated in a set of activities equalling at least two-thirds of the final score of the course or module. Thus, the student will be graded as "*No Avaluable*" (Not Assessable) if the weighting of all conducted evaluation activities, before application of the retake evaluation derived grades, is less than 67% of the final score. Any grade obtained in the activities identified as "retake activities" will substitute the grade obtained in the previous activity that the retake activity is substituting, independently of the previous grade being lower or higher than the retake grade. The retake session will be applied to grade producing activities equivalent at least to 50% of the final score. Namely, the specific items involved in the retake process will substitute the grade derived from exams 1 and 2 (40% of the global grade) and 1/6 of the grade derived from the participative and lab work (10% of the global grade, problems+homework+lab work evaluation). The retake activity will allow access to all course-related materials during the retake activity, including the Internet. To avoid unnecessary printing of grading materials or reserving spaces for retake sessions not actually needed, there will be a 48 hours period prior to the retake activity for students to declare their interest in attending the retake session. Only students having declared interest in attending the retake session through the Campus Virtual before the 48 hours deadline will be admitted to the retake activity. In case no student requests to participate, the retake session will be canceled.

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Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|-------|-----------|-------|------|-------------------|
|-------|-----------|-------|------|-------------------|

| | | | | |
|----------------------------------------------------------------|-----|-----|------|-------------------------------|
| Homework delivery | 50% | 6 | 0.24 | 4, 1, 2, 3, 9, 8, 7, 5, 6, 10 |
| Laboratory work evaluation and delivery of the lab work report | 10% | 0.5 | 0.02 | 4, 3, 10 |
| Partial exams | 40% | 4 | 0.16 | 4, 1, 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.