Nanobiotechnology and Nanomedicine

Code: 107992
ECTS Credits: 6

2025/2026

Degree	Type	Year
Microbiology	OP	4

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

No specific requirements.

Objectives and Contextualisation

To provide students with an overview of the materials and substances used in nanotechnology applied to Biomedicine, the existing preparation protocols, and the main characterization tools employed. Additionally, the course will address modification strategies to make these nanomaterials biocompatible, to direct their transport, and, when necessary, to control their internalization into cells and their biodistribution in animal models. Potential toxicity issues and selected examples of biomedical applications of these materials will also be considered.

Learning Outcomes

1. CM19 (Competence) Propose methods and procedures within the field of biochemistry, physiology and biotechnology to provide innovative responses to the needs and demands of society, and valuing their social, economic and environmental impact.
2. CM20 (Competence) Integrate knowledge of biology and biochemistry to develop an academic and professional work, and its presentation in writing or orally and publicly, working individually and in teams.

3. KM28 (Knowledge) Associate the materials and substances studied by nanobiotechnology with the applications of nanomaterials in living systems.
4. SM30 (Skill) Apply biotechnological techniques that allow the creation of advanced products with biomedical applications or improve processes.

Content

Chapter 1. Introduction. Concept of Nanomedicine. Basic concepts in nanomedicine: nanoparticles in biological environments, biocompatibility, stability, and aggregation. Functionalization of nanomaterials and their application in nanomedicine.

Chapter 2. Routes of administration of nanomaterials, advantages and disadvantages, and challenges to overcome. Cellular trafficking. Biological barriers. Smart nanomaterials: applications in therapy and diagnosis. Theranostic nanomaterials. Nanomaterials and immune response.

Chapter 3. Biosensors and integrated medical devices. Biosensors: definition, characteristics, classification, and applications. Bioreceptors and analytical nanodevices.

Chapter 4. Nanosystems for targeted drug transport and release. General concepts. Relevant physicochemical properties of drug delivery systems. Nanocarriers used in drug delivery. Challenges in nanomedicine manufacturing. Examples of clinical and marketed products.

Chapter 5. Nanoscience and nanotechnology in medical imaging techniques. Basic principles of imaging techniques: ultrasound, magnetic resonance imaging, computed tomography, positron emission tomography, contrast agents. Comparison of imaging modalities. Future trends.

Chapter 6. Tissue engineering applied to regenerative medicine. Nanofibers and nanoscaffolds for regeneration and repair of nervous and cardiovascular tissue. Nanomaterials for implants. Nanotubes as scaffolds for bone and joint growth. Nanotechnology in wound healing.

Chapter 7. Nanotoxicology. Nanoparticle toxicity. Blood compatibility. Exposure routes. Accumulation and deposition in tissues. Strategies to reduce toxicity. Environmental effects. FDA regulation for nanobiotech products.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory work	12	0.48	CM19, CM20, SM30, CM19
Problems based teaching	13	0.52	CM19, CM20, KM28, SM30, CM19
Theory classes	26	1.04	CM19, CM20, KM28, SM30, CM19
Type: Supervised			

Homework delivery and associated interaction through "Campus Virtual"	14	0.56	CM19, CM20, KM28, SM30, CM19
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	CM19, CM20, KM28, SM30, CM19
Solving problems	10	0.4	CM19, CM20, KM28, SM30, CM19
Studying for exams	10	0.4	CM19, CM20, KM28, SM30, CM19
Writing the laboratory work report	6	0.24	CM19, SM30, CM19

The course will be delivered through theoretical lectures and classroom-based practical sessions, with a strong emphasis on active participation and meaningful learning by the students. The teaching staff will act as facilitators, promoting interaction by posing questions and discussion topics that students will be expected to work on and answer. These activities will contribute to the continuous assessment system (see the corresponding section).

Fifteen minutes of one class will be allocated to completing 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
Homework delivery	50%	6	0.24	CM19, CM20, KM28, SM30
Laboratory work evaluation and delivery of the lab work report	10%	0.5	0.02	CM19, KM28, SM30
Partial exams	40%	4	0.16	CM19, CM20, KM28, SM30

This course will not apply the single assessment system.

All oral or written assessed contributions made in English will be subject to a multiplier factor ranging from a minimum of 1.0 to a maximum of 1.1.

- Coursework assessment: 50% will come from assessed submissions; 10% from the laboratory report and work; 40% from a written exam composed of two partial assessments.
- Exams: The written exam will consist of short-answer and problem-solving questions, with access to notes. The final grade for the written exam will be the arithmetic mean of the two partial exams.
- Coursework assessment: will include problem-solving, interpretation of scientific publications, literature search tasks, seminar presentations, etc., as proposed by the teaching staff.
- According to academic regulations, all submitted tasks and problem responses (minimum of 9) provided during the course will contribute to the global evaluation (50% of the final mark).
- Students unable to attend an individual assessment for justified reasons (e.g., illness, death of a first-degree relative, or accident) and who present an official justification to the Degree Coordination will be entitled to reschedule the assessment. The Degree Coordination will ensure this right is upheld with the responsible course lecturer.
- To attend laboratory sessions, students must provide proof of having passed the biosafety and safety assessments available on the Virtual Campus and must be familiar with and accept the rules for laboratory use in the Faculty of Biosciences.
- Resit procedure: To be eligible for final grade recovery, students must have been assessed in activities representing at least two-thirds of the final course score. Students will be marked as "Not Assessable" if their completed assessment activities prior to the resit account for less than 67% of the total grade.

Any grade obtained in the identified resit activities will replace the previous grade, whether higher or lower. The resit session will apply to activities representing at least 50% of the final score. Therefore, resit components will replace grades from Exams 1 and 2 (40% of the global grade) and 1/6 of the participatory and lab work score (10% of the global grade: problems, coursework, and lab evaluations).

Access to all course materials will be allowed during the resit activity. To avoid unnecessary printing or room bookings, students will have 48 hours to declare their intention to attend the resit session. Only those who register through the Virtual Campus before the deadline will be admitted. If no student registers, the resit session will be cancelled.

- Use of AI technologies: The use of Artificial Intelligence tools is permitted only for support tasks, such as bibliographic or informational searches, text correction, or translations. Students must clearly identify which parts were generated using AI, specify the tools used, and include a critical reflection on how these influenced the process and the final outcome. Lack of transparency in AI use for assessed activities will be considered academic dishonesty and may result in partial or full penalties to the grade, or more serious sanctions in severe cases.

Bibliography

Reference Books

1. Principles of Nanomedicine. Ed. Sourav Bhattacharjee, 2019, Jenny Stanford Publishing.

2. An Introductory Textbook. Rob Burgess, 2012, Pan Stanford Publishing.

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

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

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

6. Bionanotechnology. Concepts and applications, by Ljiljana Fruk and Antonina Kerbs. Cambridge University Press 2021.

Software

None

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.