# Nanobiotechnology and Nanomedicine

Code: 107987
ECTS Credits: 6

2025/2026

| Degree | Type | Year |
|---|---|---|
| Biochemistry | 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. CM35 (Competence) Review the applications of emerging technologies associated with synchrotron radiation and nanotechnology in the area of biochemistry to offer innovative solutions for societal needs.
2. CM37 (Competence) Integrate knowledge from biochemistry and molecular biology with emerging technologies associated with synchrotron radiation and nanotechnology.
3. KM38 (Knowledge) Define the basic concepts and principles of nanotechnology that are applied in biological systems.

4. KM39 (Knowledge) Describe the physical foundations and applications of spectroscopic and microscopy techniques used in structural analysis and in the study of biomolecules and biological membranes.
5. SM39 (Skill) Use digital resources to process data from spectroscopic and microscopy research, and to calculate specific parameters.
6. SM40 (Skill) Apply spectroscopy and microscopy techniques to the study of biomolecules, biomembranes and nanoparticles.
7. SM41 (Skill) Apply general and specific safety standards when performing spectroscopy or handling biological materials and nanoparticles.

## Content

Tema 1. Introducción. Concepto de Nanomedicina. Conceptos básicos en nanomedicina: nanopartículas en entornos biológicos, biocompatibilidad, estabilidad y agregación. Funcionalización de nanomateriales y su aplicación en nanomedicina.

Tema 2. Rutas de administración de nanomateriales, ventajas e inconvenientes y obstáculos a superar. Tránsito celular. Barreras biológicas. Nanomateriales inteligentes: aplicaciones en terapia y diagnóstico. Nanomateriales teranósticos. Nanomateriales y respuesta inmune.

Tema 3. Biosensores y dispositivos integrados de interés médico. Biosensores: definición, características, clasificación y aplicaciones. Bioreceptores y nanodispositivos analíticos.

Tema 4. Nanosistemas de transporte y liberación selectiva de fármacos. Conceptos generales. Características fisicoquímicas relevantes de los sistemas de liberación de fármacos ("drug delivery"). Nanotransportadores utilizados en "drug delivery". Retos en la fabricación de nanomedicinas para "drug delivery". Ejemplos de productos en fase clínica y en el mercado.

Tema 5. Nanociencia y nanotecnología en técnicas médicas de imagen. Fundamentos básicos de las distintas técnicas de imagen médica: ultrasonido, resonancia magnética, tomografía computarizada, tomografía por emisión de positrones, agentes de contraste. Comparativa de las distintas modalidades de imagen. Tendencias futuras.

Tema 6. Ingeniería de tejidos aplicada a la medicina regenerativa. Nanofibras y "nanoscaffolds" para la regeneración y reparación del tejido nervioso y cardiovascular. Nanomateriales para implantes. Nanotubos como "scaffolds" para el crecimiento óseo y articular. Nanotecnología en la reparación de heridas.

Tema 7. Nanotoxicología. Toxicidad de las nanopartículas. Compatibilidad sanguínea. Vías de exposición. Acumulación y depósito de nanopartículas en tejidos. Medidas para reducir la toxicidad de las nanopartículas. Efectos ambientales de las nanopartículas. Regulación de la FDA para productos nanobiotecnológicos.

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Laboratory work | 12 | 0.48 | CM37, KM39, SM39, SM40, SM41, CM37 |
| Problems based teaching | 13 | 0.52 | CM35, CM37, KM38, KM39, SM39, SM40, CM35 |

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|---|---|---|---|
| Theory classes | 26 | 1.04 | CM35, CM37, KM38, CM35 |
| Type: Supervised | | | |
| Homework delivery and associated interaction through "Campus Virtual" | 14 | 0.56 | CM35, CM37, KM38, KM39, SM39, SM40, CM35 |
| Tutor supervision | 2 | 0.08 | CM35, CM37, KM38, KM39, CM35 |
| Type: Autonomous | | | |
| Information retrieval, study, processing of gathered information and electronic delivery of supervised homework through "Campus Virtual" | 46.5 | 1.86 | CM35, CM37, SM39, CM35 |
| Solving problems | 10 | 0.4 | CM35, CM37, KM38, KM39, SM39, SM40, CM35 |
| Studying for exams | 10 | 0.4 | CM35, CM37, KM38, KM39, SM39, SM40, CM35 |
| Writing the laboratory work report | 6 | 0.24 | CM35, CM37, KM39, SM39, SM40, CM35 |

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 | CM35, CM37, KM38, KM39, SM39, SM40 |
| Laboratory work evaluation and delivery of the lab work report | 10% | 0.5 | 0.02 | CM37, KM38, SM39, SM40, SM41 |
| Partial exams | 40% | 4 | 0.16 | CM35, CM37, KM38, KM39, SM39, SM40 |

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: 51% 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.