UAB Universitat Autònoma de Barcelona	Nanomaterials for Theranostics Code: 45747 Credits: 3	2026/2027

Degree programme	Type	Course
Applied Nanoscience: From Materials to Devices	OP	1

Contact lecturer

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Teaching staff

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Teaching staff (external to UAB)

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Group languages

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

Prerequisites

Students must hold an official Spanish university degree or another degree issued by a higher education institution in another European higher education member state or in a third country that qualifies you for admission to a master's program. Students should have a background in Materials Science, Nanoscience, Chemistry, Physics, Biomedical Engineering or related disciplines. Furthermore, advanced English proficiency is desirable, at level B1 of the Common European Framework of Reference for Languages (CEFR). Students should be able to read and discuss scientific literature in English.

Objectives

Theranostics is an emerging interdisciplinary field that integrates therapeutic and diagnostic functions within a single platform, enabling personalized and image-guided medicine. Nanomaterials play a key role in theranostic approaches due to their unique physicochemical properties, multifunctionality, and ability to interact with biological systems.

This module provides students with a comprehensive overview of the design, synthesis, characterization, biological evaluation, and clinical translation of organic, inorganic, and hybrid nanomaterials for theranostic applications.

The module combines fundamental concepts with current research examples and critical analysis of scientific literature.

Learning outcomes

- CA35 (Plan the necessary steps for the clinical translation of a new nanodrug considering the ethical, social and gender implications.) Plan the necessary steps for the clinical translation of a new nanodrug considering the ethical, social and gender implications.
- CA36 (Propose strategies to diagnose and treat diseases considering their social and economic impact.) Propose strategies to diagnose and treat diseases considering their social and economic impact.
- CA37 (Design nanoparticles that combine diagnostic and therapeutic agents.) Design nanoparticles that combine diagnostic and therapeutic agents.
- KA36 (Identify the physical and chemical properties necessary in a nanomaterial for use in theranostics.) Identify the physical and chemical properties necessary in a nanomaterial for use in theranostics.
- KA37 (Define the different strategies in the improvement of the targeting of nanomaterials to the place of the organism affected by the disease.) Define the different strategies in the improvement of the targeting of nanomaterials to the place of the organism affected by the disease.
- SA42 (Identify the best type of nanoparticle for a given medical treatment.) Identify the best type of nanoparticle for a given medical treatment.
- SA43 (Analyse images acquired by different medical diagnostic techniques.) Analyse images acquired by different medical diagnostic techniques.
- SA44 (Predict the accumulation of nanoparticles in certain organs of the human body according to their characteristics.) Predict the accumulation of nanoparticles in certain organs of the human body according to their characteristics.

Contents

- Fundamentals of Nanomaterials for Theranostics. Integration of diagnostic and therapeutic functionalities in nanostructured platforms. Design of Multifunctional Nanomaterials. Bio-Nano Interactions. Key design parameters and structure-function relationships.

- Organic Nanomaterials for Smart Drug Delivery. Controlled release with stimuli-responsive systems. Passive and active targeting strategies. Photodynamic therapy. Synthesis and Characterization.

- Inorganic Nanomaterials for magnetic hyperthermia, photothermal therapy. Oxidative and thermal damage mechanisms. Radiosensitization. Imaging-Therapy Integration. Multifunctional theranostic agents. Advanced Imaging Modalities.

- Hybrid Nanomaterials. Organic-Inorganic Hybrid Platforms. Design and fabrication. Synergistic functionalities. Multifunctional Theranostic Systems. Combined imaging and therapy. Stimuli-responsive hybrid nanostructures. Current research examples and emerging clinical applications.

- Preclinical Evaluation. Efficacy and safety studies. Animal models. Biological barriers to clinical translation. Clinical trial phases. Scale-up and manufacturing. Approved nanomedicines and nanotheranostic platforms in clinical development.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Scientific literature search and reading	10	0.4	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44

Preparation of paper presentation	10	0.4	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44
Laboratory tour	1	0.04	
Classes and seminars	18	0.72	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44
Study and review of lecture materials	18	0.72	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44
Preparation of assessment activities	10	0.4	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Exam	30%	2	0.08	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44
Participation in classes	30%	2	0.08	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44
Scientific paper review and oral presentation	40%	4	0.16	CA35, CA36, CA37, KA36, KA37, SA42, SA43, SA44

Description of Assessment Activities

1. Review and Oral Presentation of a Scientific Article (40%)

Students will present and discuss a recent scientific paper related to nanotheranostics. Previous to the presentation, students will submit a critical report (1 page) highlighting strengths and weaknesses of the scientific study.

Evaluation criteria:

- Understanding of scientific background (20%)
- Critical análisis (20%)
- Quality of presentation (20%)
- Communication skills (20%)
- Ability to answer questions (20%)

2. Participation in classes (30%)

- Assistance to classes is expected
- At the end of each class there will be a time for discussion
- Active participation in scientific discussions will contribute to the final module grade.

3. Exam (30%)

Short-answer and integrative questions will cover:

- Theranostic concepts.
- Nanomaterial design.
- Imaging modalities.
- Therapeutic strategies.
- Biological evaluation and translation.

Bibliography

- Nanomaterials in Theranostics. Zhiyuan Gao and Dan Ding. Chapter 1 in Handbook of Nanomaterials, Volume 2. DOI: https://doi.org/10.1016/B978-0-323-95513-3.00011-3.
- AI-driven nanomedicine for cancer theranostics. Tiwari et al. Molecular Cancer (2026) 25:78 . https://doi.org/10.1186/s12943-025-02563-9
- G. Cao, Nanostructures and nanomaterials: synthesis, properties and applications, Imperial College Press, London, 2004. Link.
- G. Cao and Y. Wang, Nanostructures and nanomaterials : synthesis, properties, and Applications, 2011, World Scientific.
- G. A. Ozin, , A. C. Arsenault, , L. Cademartiri, Nanochemistry : a chemical approach to nanomaterials, 2009, Royal Society of Chemistry. Link.

Students will be provided with recent review papers and original research articles throughout the course.

Software

No specific software is required. Students are expected to use standard scientific and office software for literature management and presentation preparation.

Use of IA:

For this subject, the use of Artificial Intelligence (AI) technologies is allowed exclusively in support tasks, such as bibliographic or information searches, text correction or translations. The student must clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how these have influenced the process and the final result of the activity. The lack of transparency of the use of AI in this assessable activity will be considered a lack of academic honesty and may lead to a partial or total penalty in the grade of the activity, or greater sanctions in serious cases.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TEm) Theory (master)	1	English	first semester	afternoon