Use of languages
Principal working language: english (eng)

Contact
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Email: Desconegut

Teachers
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Ana Maria López Periago
Víctor Franco Puntes
Martí Gich García
Anna Laromaine Sague

External teachers
Nora Ventosa

Prerequisites
The same admission requirements as the ones to be admitted to the Master's Degree:

A degree certificate in Nanoscience and Nanotechnology, Physics, Chemistry, Geology, Biochemistry, Biotechnology, Telecommunication Electronic Engineering, Materials Engineering, or another degree whose contents fit the profile of this master's degree. You may also be admitted to the master's degree if you hold an official university degree issued in Spain (in compliance with the legal ordinance prior to the Royal Decree 1393/2007) or in another country, as long as its contents are closely related to the subjects offered in the master's degree.

- Good level of English, equivalent to Level B2 of the Common European Framework of Reference for Languages.

Objectives and Contextualisation
The objective of this course is to give a broad overview of how nanotechnology is impacting medicine, biomaterials and enviroment remediation. Brief basic concepts in nanomedicine and biomaterials will be detailed at the beginning of the course. Following the introduction, the course is divided in five main sections: Nanotoxicology, Drug delivery, Thermal Therapies, Tissue Engineering, and environment remediation.
Skills

- Analyse research results to obtain new products or processes, assessing their industrial and commercial viability with a view to transferring them to society.
- Analyse the benefits of nanotechnology products, within one’s specialisation, and understand their origins at a basic level.
- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Continue the learning process, to a large extent autonomously.
- Designing and applying nanomaterials and nanoparticles in diagnosis and therapy in biological systems. (specialty nanobiotechnology)
- Identify and distinguish the synthesis/manufacture techniques for nanomaterials and nanodevices typically adopted in one’s specialisation.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Seek out information in the scientific literature using appropriate channels, and use this information to formulate and contextualise a research topic.
- Show expertise in using scientific terminology and explaining research results in the context of scientific production, in order to understand and interact effectively with other professionals.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Learning outcomes

1. Analyse research results to obtain new products or processes, assessing their industrial and commercial viability with a view to transferring them to society.
2. Analyse the basic principles of cancer therapies.
3. Analyse the differences between different drug liberation systems.
4. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
5. Continue the learning process, to a large extent autonomously.
6. Define the concepts of biocompatibility and toxicity in nanomaterials.
7. Define the properties needed for nanomaterials that are efficient in water remediation.
8. Describe the concept of biomineralisation and the role of the different components involved.
9. Describe the drug encapsulation methods.
10. Describe the most important characteristics for designing materials for tissue regeneration.
11. Describe the principles of tissue engineering.
12. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
13. Recognise the role of particle size in bioavailability.
14. Seek out information in the scientific literature using appropriate channels, and use this information to formulate and contextualise a research topic.
15. Show expertise in using scientific terminology and explaining research results in the context of scientific production, in order to understand and interact effectively with other professionals.
16. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
17. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Content

Module in which the interrelations of nanomaterials in biological systems, and its impact on toxicity, tissue engineering, drug delivery, thermal therapies and water remediation will be exposed.

Content:

**Biocompatibility:** Interactions of nanomaterials with biological matter. Toxicity of nanomaterials.
**Tissue engineering:** molecular and polymeric gels. Biomineralization. Scaffoldings and cell growth. Importance of 3D validation of materials for medicine. Material applications in tissue regeneration.


**Principles of thermal therapies:** hyperthermia, photothermal, magneto, termoradio therapy to target and destroy cancer cells. Analysis of appropriate nanomaterials. Current methods and future prospects.

Description of the necessary properties of **nanomaterials for water remediation.** Techniques based on photocatalysis, adsorption etc.

**Methodology**

Lectures

Seminars

Practical cases

Oral presentation of works

Preparation of papers

Personal study

Reading articles / reports of interest

**Activities**

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<tr>
<th>Title</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning outcomes</th>
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<td>Lectures</td>
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<td>1.44</td>
<td>2, 3, 6, 7, 8, 9, 10, 11, 13</td>
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<tr>
<td>Oral presentations of works</td>
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<td>0.28</td>
<td>4, 5, 12, 17</td>
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<tr>
<td>Personal study</td>
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<td>1.2</td>
<td>2, 3, 6, 7, 8, 9, 10, 11, 13</td>
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<tr>
<td>Practical cases</td>
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<td>0.16</td>
<td>17</td>
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<tr>
<td>Preparation and presentations of scientific papers</td>
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<td>0.4</td>
<td>1, 14, 15</td>
</tr>
<tr>
<td>Reading articles and reports</td>
<td>20</td>
<td>0.8</td>
<td>1, 14, 15</td>
</tr>
<tr>
<td>Seminars</td>
<td>2</td>
<td>0.08</td>
<td>3</td>
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**Evaluation**

20% Assistance and class participation

40% Short oral presentations (10 min) of research papers related to the topics and questions of the evaluation panel

40% Multiple choice exam
### Evaluation activities

<table>
<thead>
<tr>
<th>Title</th>
<th>Weighting</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning outcomes</th>
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</thead>
<tbody>
<tr>
<td>Assistance and class participation</td>
<td>20%</td>
<td>38</td>
<td>1.52</td>
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<td>Multiple choice exam</td>
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<tr>
<td>Short oral presentations</td>
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<td>2</td>
<td>0.08</td>
<td>1, 4, 14, 15, 17</td>
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</table>

### Bibliography

1. **Biocompatibility. Interaction of nanomaterials with biological matter. Toxicity of nanomaterials.**
   1.5. GoodNanoGuide shares best practices, how to handle nanomaterials safely, [http://www.nanowiki.info/%5BGoodNanoGuide%20shares%20best%20practices%3A%20how%20to%20handle%20nanomaterials%20safely%5D](http://www.nanowiki.info/%5BGoodNanoGuide%20shares%20best%20practices%3A%20how%20to%20handle%20nanomaterials%20safely%5D)
   1.7. G.J. Oostingh et al. Problems and challenges in the development and validation of human cell-based assays to determine nanoparticle-induced immunomodulatory effects. Particle and Fibre Toxicology 8, 8 (2011).
   1.9. "Occupational Disease and Nanoparticles"
   [http://www.cdc.gov/niosh/blog/nsb082409_nano.html](http://www.cdc.gov/niosh/blog/nsb082409_nano.html)

   2.1. "Introduction to biomaterials". Editor: Donglu Shi. Tsinghua University Press. World Scientific 2005
   2.2. "Principles of Tissue Engineering". Edited by: Robert Lanza, Robert Langer and Joseph Vacanti. 2007 Elsevier Inc
2.5. "Nanotechnology for tissue engineering: Need, techniques and applications" Journal of pharmacy research 7 (2013) 200-204.


2.7. From 3D cell culture to organs-on-chips, Dongeun Huh1, Geraldine A. Hamilton1 and Donald E. Ingber, Trends in Cell Biology December 2011, Vol. 21, No. 12


3.1. Patrick Couvreur1 and Christine Vauthier, Nanotechnology: Intelligent Design to Treat Complex Disease, Pharmaceutical Research, 2006, 23, 1417-1448

3.2. Rupa R. Sawant and Vladimir P. Torchilin, Liposomes as 'smart' pharmaceutical nanocarriers, Soft Matter, 2010, 6, 4026-4044


3.5. Owen R. Davies, Andrew L. Lewis, Martin J. Whitaker, Hongyun Tai, Kevin M. Shakesheff b, Steven M. Howdle, Applications of supercritical CO2 in the fabrication of polymer systems for drug delivery and tissue engineering, Advanced Drug Delivery Reviews 2008,60, 373-387

Gene therapy:


4. Principles of thermal therapies:

A-Fundamentals of hyperthermia (without nanomaterials) [4.1 - 4.12]

B- Magnetic hyperthermia & Photothermal therapy [4.13 - 4.14]

C- Examples of appropriate nanomaterials [4.15 - 4.19]


5. Description of the necessary properties of nanomaterials for environmental remediation. Techniques based on photocatalysis, adsorption etc.

General:


Specific:


