# 69313 - Nano-therapy

**Información del Plan Docente**

| | |
|---|---|
| **Academic Year** | 2016/17 |
| **Academic center** | 110 - Escuela de Ingeniería y Arquitectura |
| **Degree** | 547 - Master's in Biomedical Engineering |
| **ECTS** | 3.0 |
| **Course** | 1 |
| **Period** | Second semester |
| **Subject Type** | Optional |
| **Module** | --- |

## 1.Basic info

## 1.1.Recommendations to take this course

## 1.2.Activities and key dates for the course

## 2.Initiation

## 2.1.Learning outcomes that define the subject

## 2.2.Introduction

## 3.Context and competences

## 3.1.Goals

## 3.2.Context and meaning of the subject in the degree

## 3.3.Competences

## 3.4.Importance of learning outcomes

## 4.Evaluation

## 5.Activities and resources

## 5.1.General methodological presentation

General methodological overview

The learning method used is based on the cooperative work of the teacher and the student. The method will follow the traditional approach based on lectures but supported by the active participation of the students. Therefore, participation and discussion during the lectures will be promoted.

## 5.2.Learning activities

# 69313 - Nano-therapy

The learning process used during the lectures will be based on:

**A01** For all the rest of the acridities including student's assignments, evaluations, projects, public defenses and personal study) 49 hours will be a ssigned.

**A02 (classroom lectures) = 26 hours**

The following training activities will be proposed in order to reach the learning results above proposed achieving the designed abilities that the student must acquire.

**A02 Participative lectures** (26 hours).The professor will describe the main contents of the course. This activity will take place in the classroom. Student's attendance is a must.

**A1 Carry out required assignments or research project**

The professor in charge of the course will propose relevant topics related to the course trying to match it to the student's personal interests, professional development or thesis research project (if any)

The research project will have the structure of a scientific paper with the following structure:

-Title

-Author

-Abstract: With no more than 250 words the student should summarize the content described in the paper and its implications in the Nanobiomedical field.

-Introduction: 1 or 2 paragraphs, between 250 to 750 words defining and describing the topic of the review paper.

- Review of the state-of-the-art: There is not wording limitation in this section. This section will review the most relevant advances in the field related to the topic, highlighting those that supposed a breakthrough in the area. Future directions and implications for the coming years should also be described.

-Conclusions: A summary of the main conclusions of the work. A total of 1 or 2 paragraphs with a maximum of 250-750 words will be required.

-Bibliography: Main, relevant references used for the preparation of the manuscript.

The student will give a talk summarizing the main aspects of his/her work in a public defense.

A3: Tutorship: Tutoring time to discuss with the professor in charge of the course all the contents and aspects related to the course in order to solve any question or doubt that he/she might have will be at the student's disposal.

**A4: Evaluation assessment.** W riting exam. The relevant information about the exam is described in section 4 (Global evaluation).

## 5.3.Program

**Theory and contents of the course:**

Section 1. Nanotherapy overview. Introduction to drug and gene delivery. Magnetic and photothermal hyperthermia, and tissue engineering.

Section 2. Drug delivery overview. Drug adsorption and desorption mechanisms in mesoporous and microporous materials and polymeric matrixes. Drug delivery routes. Drug encapsulation and conjugation to nanocarriers. Nanoparticles functionalization. Mechanism of evading the reticuloendothelial system (RES). Physical and chemical synthesis of organic (micelles, liposomes, dendrimers, etc.) and inorganic nanomaterials (SiO 2 , TiO 2 , etc ). Biomimetics.

Section 3. Gene therapy. Gene therapy overview. Introduction to gene therapy: basics, gene nanocarriers, gene transfer mechanisms.

Section 4. Main nanocarriers in drug delivery. Tracers (MRI, fluorescent tomography, sonoacustic. Dendrimers, polymers, micelles. Stimuli responsive polymers: photosensitive, thermosensitive, pH sensitive, etc. Other aspects including the stoichiometry control will also be discussed. Inorganic nanoparticles, applications in drug delivery. Meso and micro nanoparticles. Microcapsules and microspheres. Biodegradable silica gel.

Section 5. Application of nanoparticles in theranostics. Nanoparticles as tracers for in-vivo (MRI, fluorescent tomography, sonoacustic, etc..) Theranostic nanomaterials with diagnosis/ therapy dual role. Biological barriers to theranostic nanoparticle for drug/gene delivery.

Section 6. Localized drug delivery systems: active and passive mechanisms. Active mediated techniques in drug delivery: magnetic, light, ultrasound, etc. Biochemical mediated drug delivery. Drug conjugated nanocarriers and bio-receptors. Chemical interactions: lectin-carbohidrate, ligand-receptor and antigen-antibody.

Section 7. Pharmacokinetics and pharmacodynamics. Main requirements to translate the production of therapeutic nanocarriers from lab to the market . Analytical techniques to track the drug delivery and assessment of side effects. Description of commercialized nanocarriers.

## 5.4.Planning and scheduling

The course calendar is defined by the EINA (Engineering School calendar) and they will be posted in the EINA website as well as in the Master website ( http://www.masterib.es ). Deadlines for project presentation or to submit the required assignments will be posted in the learning platform moodle ( https://moodle.unizar.es/ ) or in the Alfresco server.It is mandatory to follow the safety procedures described by the University of Zaragoza to work in laboratories in practical sessiones: safety googles and coat.

## 5.5.Bibliography and recomended resources

# 69313 - Nano-therapy

| | |
|---|---|
| **BB** | Nanobiotechnology Inorganic Nanoparticles vs Organic Nanoparticles / Edited by Jesus M. de la Fuente and V. Grazu. Elsevier, 2012 |
| **BC** | Gold nanoparticles: interesting optical properties and recent applications in cancer diagnostic and therapy. Por: Huang, Xiaohua; Jain, Prashant K.; El-Sayed, Ivan H.; et ál.. En: NANOMEDICINE Volumen: 2 Número: 5 Páginas: 681-693 Fecha de publicación: OCT 2007 |
| **BC** | Nanomedicine-Challenge and Perspectives. Por: Riehemann, Kristina; Schneider, Stefan W.; Luger, Thomas A.; et ál.. En: ANGEWANDTE CHEMIE-INTERNATIONAL EDITION Volumen: 48 Número: 5 Páginas: 872-897 Fecha de publicación: 2009. Weinheim : Wiley-VCH, 1998- [Publicación periódica] |

**LISTADO DE URLs:**

Gold nanoparticles in nanomedicine: preparations, imaging, diagnostics, therapies and toxicity. Por: Boisselier, Elodie; Astruc, Didier. CHEMICAL SOCIETY REVIEWS Volumen: 38 Número: 6 Páginas: 1759-1782 Fecha de publicación: 2009 [http://pubs.rsc.org/en/content/articlepdf/2009/cs/b806051g]

Multifunctional Magnetic Nanoparticles: Design, Synthesis, and Biomedical Applications. Por: Gao, Jinhao; Gu, Hongwei; Xu, Bing. ACCOUNTS OF CHEMICAL RESEARCH Volumen: 42 Número: 8 Páginas: 1097-1107 Fecha de publicación: AUG 2009 [http://pubs.acs.org/doi/abs/10.1021/ar9000026@proofing]

Nanocarriers as an emerging platform for cancer therapy. Por: Peer, Dan; Karp, Jeffrey M.; Hong, SeungPyo; et ál.. NATURE NANOTECHNOLOGY Volumen: 2 Número: 12 Páginas: 751-760 Fecha de publicación: DEC 2007 [https://www.researchgate.net/publication/51427734_Nanocarriers_as_an_Emerg