Year : 2017/18

# 3378 - Bachelor's (degree) programme in Biomedical Engineering
# 25030 - Nanomedicine and Nanobiotechnology: Introduction and Applications

## Syllabus Information

**Academic Course:** 2017/18

**Academic Center:** 337 - Polytechnic School

**Study:** 3378 - Bachelor's (degree) programme in Biomedical Engineering

**Subject:** 25030 - Nanomedicine and Nanobiotechnology: Introduction and Applications

**Credits:** 4.0

**Course:**

**Teaching languages:** Theory: Grupo 1: English
Practice: Grupo 101: English
Grupo 102: English
Grupo 103: English
Seminar: Grupo 101: English

**Teachers:** Paula Zamora Perez, Maria Pilar Rivera Gil, Dionysia Tsoutsi

**Teaching Period:** Quarterly

## Presentation

The course is a 4 ETCS optional subject offered at the Biomedical Engineering degree that will take place during the first trimester of the 3rd year. The whole course will be given in English.

## Associated skills

This is a group of lectures, seminars, and lab classes aiming at presenting how biomedicine can profit from nanotechnology.

## Learning outcomes

Fundamental concepts in nanotechnology will be given. Those include the relevance of surface, colloids, or the nanometer scale. Then the lectures will cover key aspects of the synthesis of nanostructured materials (top down *versus* bottom up approaches), material and biological characterization techniques (*i.e.* optical microscopies, spectroscopy, zeta potential, hyperspectral imaging, nanotoxicity, bio-distribution, *etc*), and biomedical applications (*i.e.,* control release of drugs, bio-sensing, imaging, hyperthermia, *etc*).

## Contents

**1. Lectures: 17 hours.**

1) Introduction to nanobiotechnology

2-4) surface and colloidal systems

5) Inorganic synthesis of nanoparticles

6) Organic synthesis: polyelectrolyte multilayer capsules

7) Electron microscopy

8) Spectroscopy 9) Surface-enhanced Raman scattering

10) Optical microscopy: Fluorescence and Dark-field

11) Hyperspectral imaging

12) Enhanced darkfield optical microscopy with high resolution hyperspectral imaging for nano-scale imaging and analysis 13) Electrically charged surfaces

14) Biomedical applications of polyelectrolyte multilayer capsules

15) Biomedical applications of inorganic nanoparticles

16) Biodistribution of inorganic nanoparticles

17) Nanoparticle-assisted hyperthermia for the treatment of tumors

**2. Seminars: 10 hours**.

Scientific papers showing the state of the art in engineered nanoparticles for biomedicine will be distributed to the students. They must prepare and give in groups of 2 people an oral presentation (30 minutes) to the class and be prepared for a 15 minutes' discussion.

**3. Lab classes: 18 hours.**

There will be 3 types of experiments to be performed by each student. Each experiment will last 6 hours. The students must prepare a report of each experiment.

*Experiment 1* will be dedicated to the synthesis of plasmonic nanoparticles and its follow up with UV-visible spectroscopy.

*Experiment 2* will characterize the physicochemical properties of the nanoparticles. The technique that applies to this type of nanoparticles are: Hyperspectral dark field imaging, UV-visible spectroscopy, and the use of Lambert Beer law to estimate the concentration of the nanoparticles in dispersion.

*Experiment 3* will be the culturing and nanoparticle exposure of cancer. The treated cells will be imaged with the confocal

laser scanning microscope.

## Evaluation

Attendance to the different blocks (lectures, seminars and lab classes) on time is compulsory to be evaluated.

The evaluation criterium is:

- Oral presentations and the discussion will contribute to assess the level of comprehension of the different topics given during the lectures: 60%

- Lab classes reports to assess the experimental impact in biomedical engineering of theoretical concepts: 40%

Students that not pass the assessment will have a second opportunity in July in form of a writing examination.