Biomedical applications of nanotechnology

Academic Year: (2018 / 2019) **Review date: 31-10-2018**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: MUÑOZ BARRUTIA, MARIA ARRATE

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Students are strongly advised to have completed the subjects Chemistry, Materials Science and Engineering, Introduction to the design of medical instrumentation, Signals and systems and Introduction to Biomaterials.

OBJECTIVES

The students will learn the basic principles of nanotechnology applied to biomedical problems in lectures and team work activities on reviewing of articles and practices in the laboratory.
The course will focus on the design of devices based on nanotechnologies and the preparation of nanoparticles. It will also address the clinical application of these technologies in diagnosis (including imaging) and therapy, and its application in biomedicine.
Students will familiarize themselves with the main techniques for the synthesis, characterization and biofunctionalization of the most common nanomaterials and their use in biometric devices or as contrast agents for diagnosis and therapy.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- INTRODUCTION TO NANOTECHNOLOGY
2.- IMAGING AND CHARACTERIZING THE NANOSCALE
3.- NANOSENSORS FOR CLINICAL APPLICATIONS
4.- IMAGING NANODEVICES
5.- NANODEVICES FOR MANIPULATION OF CELLS AND BIOMOLECULES
6.- NANOPARTICLES FOR DRUG AND GENE DELIVERY
7.- MODIFICATION AND FUNCTIONALIZATION OF NANOPARTICLES FOR DIAGNOSIS AND THERAPY
8.- POTENTIAL USE OF DNA FOR ELECTRONIC AND COMPUTER APPLICATIONS
9.- SAFETY AND TOXICITY CONCERNS OF NANOSYSTEMS

Lab practices
The dates will be announced early in the course.
Practices will cover preparation of liposomes, synthesis of gold nanomaterials, gold nanoparticles-based sensors, design and characterisation of nanotechnology based sensors, and electronics for nanotechnology.

LEARNING ACTIVITIES AND METHODOLOGY

Each section of the program will be divided into lectures and practical sessions or seminars.
The teaching methodology is based on master classes that introduce the fundamental concepts, seminars in which examples are illustrated in detail, and practical sessions in the laboratory.
Students are required to read the assigned documentation prior to conferences and seminars. The lectures will be used to highlight and clarify some difficult or interesting points of the corresponding lesson. The seminars will be devoted mainly to the interactive discussion with the students and to conduct partial exams.
The tutoring regime will be published in Aula Global.

ASSESSMENT SYSTEM

Grading will be based on continuous evaluation and a final exam covering the whole subject, including invited lectures and seminars. Tutorship sessions and tutorial classes will be held prior to the final exam upon students request.
Failure to attend any test or submit the exercises before the deadline will result in a mark of zero in the corresponding continuous evaluation block (see below).

GRADING:

Total score: 10 points
Continuous evaluation: 6 points out of 10
Final exam: 4 points out of 10

CONTINUOUS EVALUATION: It accounts for up to 60% of the final score of the subject (6 points of the TOTAL SCORE), and includes two components:
1) Homeworks and midterm exams: Three points of THE TOTAL SCORE. Deadlines and test dates will be announced at least one week in advance.
2) Three point of THE TOTAL SCORE: laboratory practices and exercises

FINAL EXAM: The final exam will cover the whole subject, including invited lectures and seminars, and will account for the 40 % of the final score (4 points of the TOTAL SCORE). The minimum score in the final exam to pass the subject is 4 over 10, notwithstanding the mark obtained in continuous evaluation.

EXTRAORDINARY EXAM: The mark for students attending any extraordinary examination will be either
a) 100% extraordinary exam mark, or
b) 40% extraordinary exam mark and 60% continuous evaluation if it's available in the same course.

ACADEMIC CONDUCT: Unless specified, all exams will be closed-book, closed-notes, no PC or mobile phone, or anything else other than a writing implement and the exam itself. Plagiarism, cheating or other acts of academic dishonesty will not be tolerated. Any infractions whatever will result in a failing grade.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- BS Murty, P Shankar, B Raj, BB Rath, J Murday Textbook of Nanocience and Nanotechnology, Springer University Press, 2013
- C. Sharma Drug Delivery Nanosystems for Biomedical Applications, Elsevier, 2014

ADDITIONAL BIBLIOGRAPHY

- A. Offenhäusser, R. Rinaldi (Editors) Nanobioelectronics - for Electronics, Biology and Medicine, Nanostructure Science and Technology Series, Springer, 2009
- A. P. Lee, L. James Lee (Editors) Biological and Biomedical Nanotechnology, Volume I, Biological and Biomedical Nanotechnology, Springer, 2006
- Kevin C. Honeychurch (Editor Nanosensors for Chemical and Biological Applications: Sensing with Nanotubes, Nanowires and Nanoparticles, Woodhead Publishing, 2014
- Mauro Ferrari, Ph.D., Editor-in-Chief. BioMEMS and Biomedical Nanotechnology. Vol. 1 Biological and Biomedical Nanotechnology, Springer, 2006
- Paras N Prasad Introduction to Nanomedicine and Nanobioengineering: Transforming Healthcare with Nanotechnology, John Wiley and Sons, 2012
- Rajaventhan Srirajaskanthan, M.D.,Victor R. Preedy, Ph.D Nanomedicine and Cancer, CRC Press, 2012
- Vijay K. Varadan,LinFeng Chen,Jining Xie Nanomedicine: Design and Applications of Magnetic Nanomaterials, Nanosensors , John Wiley and Sons, 2008