Foundations of Bioengineering

Academic Year: (2022 / 2023) **Review date: 21-06-2022**

Department assigned to the subject:

Coordinating teacher: GARCIA DIEZ, MARTA

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

OBJECTIVES

This course provides an updated perspective of the major developments in biomedical engineering, and introduces the way biology, mathematics and engineering can be applied to biomedical problems. The fundamental principles that underlie biomedical engineering design, analysis, and modelling procedures will be developed in addition to practical examples of the techniques commonly used to solve them. Students will thus acquire an overview of most of the major fields of activity in which biomedical engineers are engaged.

DESCRIPTION OF CONTENTS: PROGRAMME

Introduction to bioengineering:
0. Introduction to biomedical engineering: the role of a biomedical engineer.

Biology module:

General blocks:

- Fundamentals of modern biomedicine: Cellular and molecular biology, genomics and bioinformatics
- Regenerative medicine and tissue engineering

Specifics:

B1. Molecular Biology I: Basic concepts of chemistry applied to Biology
B2. Molecular Biology II: Proteins, Lipids, Polysaccharides, Nucleic Acids
B3. Cell Biology I: Cell structure and function
B4. Cell Biology II: Cell metabolism, signalling, communication
B5. Stem Cells: What are they, how are they obtained, what is their current utility and future potential?
B6. Regenerative Medicine / Tissue Engineering I: Is it possible to produce organs or tissues? Basic Methods and principles
B7. Regenerative Medicine II: State of the art, and examples of organ and tissue generation

Engineering module:

General blocks:

- Basic concepts about Medical Instrumentation and devices: Electricity and Electronics
- Medical images: X-rays, nuclear medicine, magnetic resonance, ultrasound and medical optics

Specifics:

E1. Bioelectricity: the language of our cells
E2. Bioinstrumentation: how to measure what is going on
E3. Implants and brain machine interfaces: talking to the machine
E4. Medical Imaging: seeing and understanding form
E5. Molecular imaging: discovering and measuring the function
E6. Surgical Room, the last frontier: Bringing technology to the surgeon.

LEARNING ACTIVITIES AND METHODOLOGY

The program will be divided into master classes, seminars and laboratory practical sessions. Students are required to read or resolve assigned chapters, articles, problems, etc., before the corresponding classes.
To facilitate learning, students will receive the slide of each class and the bibliography.
The seminars and Journal Clubs will contain the discussion of relevant scientific articles and problems that will be presented by the students.
Students will have laboratory sessions for each module of the subject (Biology module and Engineering module), where they will carry out an experimental design with the help of the teaching team.

ASSESSMENT SYSTEM

Grading will be based on continuous evaluation (tests, journal clubs and laboratory sessions) and a final exam covering the whole subject. Tutorial classes will be held prior to the final exam upon student's request.

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

CONTINUOUS EVALUATION:
1) Continuos evaluation test and students presentations (Journal Club): 1.5 points continuos evaluation test Biology Modulus +1.5 points continuos evaluation test Engineering Modulus + 1.5 points Journal Club presentation).
2) Experimental development: 1.5 point lab notebook

FINAL EXAM: The final exam will cover the whole subject (and may include the laboratory sessions) and will account for the 40 % of the final score. The minimum score in the final exam to pass the subject is 4 over 10 (not with standing the mark obtained in continuous evaluation).

BASIC BIBLIOGRAPHY

- J.D. Bronzino. The Biomedical Engineering Handbook, CRC Press, 1995
- J.D. Enderle, S.M Blanchard, and J.D. Bronzino. Introduction to Biomedical Engineering, Boston: Elsevier Academic Press, 2005
- J.G. Webster. Medical Instrumentation Application and Design, John Wiley Sons, Inc., 2010
- Jerry L. Prince, Jonathan Links. Medical Imaging Signals and Systems., Prentice Hall., 2014
- M. Saltzman. Biomedical Engineering: Bridging Medicine and Technology., Cambridge University Press, 2009