Introduction to Bioengineering

Academic Year: (2018 / 2019) **Review date: 11-12-2018**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: ABELLA GARCIA, MONICA

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

It is convenient, although not a requirement, to have a good previous background on:
- Physics
- Chemistry
- Biology

OBJECTIVES

The 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 modeling 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 and they will also have the opportunity to see these technologies in practice by visiting the real environment of a modern hospital (Gregorio Marañón) and an important research center (CIEMAT).

DESCRIPTION OF CONTENTS: PROGRAMME

The discipline of biomedical engineering has evolved over the past fifty years, making it clear that it includes a diverse, seemingly all-encompassing range of fields of specialization such as bioinstrumentation, bioimaging, biomechanics, biomaterials, and biomolecular engineering. The program below constitutes a selection of the most important basic tools that will be necessary for a biomedical engineer, suited to a 6 credit course.
PROGRAM:
- Introduction to Biomedical Engineering: The Role of a Biomedical Engineer
- Basics on Medical Instrumentation and Devices: Electricity and Electronics
- Medical Imaging: Digital image processing, X-Ray, Nuclear Medicine, Magnetic Resonance, Ultrasound and Medical Optics
- The foundations of modern Biomedicine: Cell and Molecular Biology, Genomics and Bioinformatics
- Regenerative Medicine and Tissue Engineering

LEARNING ACTIVITIES AND METHODOLOGY

Teaching methodology will be mainly based on the following modules:

* Introduction: Presentation of the course, the degree and the tracks and discussion of the role of the Biomedical Engineer and possible professional outcomes. Almost half of the session will be interactive, conducted by the doubts and questions from the students.

* Basic concepts: Theoretical sessions covering basic concepts that will be vital to the professional development in the different areas: Tissue Engineering, Medical Imaging and Biomedical Instrumentation.

* Practical cases: Example of current tecnology, examining the involved disciplines and identification of the application of the basic concets seen in the theoretical sessions.

* Laboratory sessions: Practical sessions where the students see the comented technologies and use different tolos that they will encounter in theri professionl life. A report guideline will be handed to be filled up during the session.

* Visits: Visits to two centers, Gregorio Marañón Hospital and CIEMAT research Center, that will allow the students to see firsthand how daily work is in these environments and what type of technologies are used. A list of questions will be handed to be filled up during the session.

Grading will be based: 60% of continuous evaluation based mainly on short exams and laboratory/visits reports and 40% of a final exam covering the whole subject. Help sessions and tutorial classes will be held prior to the final exam.

Attendance to lectures and short-exams is not compulsory. However, failure to attend any exam will result in a mark of 0 in the corresponding continuous evaluation block.

The practical sessions may consist on laboratory work or visits to research or clinical centers. A laboratory report may be required for each of them. The attendance to practical sessions is mandatory. Failure to hand in the laboratory reports or unjustified lack of attendance will result in 0 marking for that continuous evaluation block.

ASSESSMENT SYSTEM

Continuous evaluation: It accounts for up to 50% of the final score of the subject, and includes three components:
1) Short-exams: These short exams will be 15-minute tests covering previous sessions that will be advertised at least one week in advance.
2) Practical sessions/visits: They will be assessed through laboratory/visit reports and/or questionnaires that will be handed in at the beginning of each session. Attendance to all practical sessions is mandatory.
3) Student participation: It includes contribution to seminars, forum in Aula global, attitude, etc.

Final exam: The final exam will cover the whole subject and will account 50% of the final score. It will consist on two parts; the minimum score for each part to pass the subject is 4.0 over 10, notwithstanding the mark obtained in the continuous evaluation.

Extraordinary exams: The mark for students attending any extraordinary examination will be the maximum between:
a) 100% exam
b) 40% exam and 60% continuous evaluation if it is available in the same course

Academic conduct: 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 whatsoever will result in a failing grade.

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

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, Ed., 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.