Introduction to the design of medical instrumentation

Academic Year: (2020 / 2021) **Review date: 02-02-2021**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: GOMEZ CID, LIDIA

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Introduction to bioengineering
Electronic technology in biomedicine
Measuring instrumentation
Signals and Systems or Digital Signal Processing

OBJECTIVES

The student that successfully finishes this course should understand the biomedical application, specify the user and technical specifications, and provide a complete protocol for the design of a medical instrument.
Besides, after the completion of this course the student should be able to implement a functioning medical instrument using state-of-the-art electronics and sensor technologies.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Biomedical Instrumentation
2. Signal Amplification
3. Signal Filtering
4. Electrical Safety
5. Electrocardiology. ECG characteristics.
6. Electroencephalography. EEG characteristics
7. Other Biopotential Recordings: EMG, ENG, ERG, EOG
8. Biopotential Amplifiers
9. Electrodes and Electrolytes.
10. Sensors: biophysics, design, applications.
11. Introduction to Signal Digitalization
12. Therapeutic and Prosthetic Devices
13. Pressure and Sound Measurements
14. Flow and Volume Measurements
15. Introduction to Optical Measurement Systems

LEARNING ACTIVITIES AND METHODOLOGY

Teaching methodology will be mainly based on lectures, seminars and practical sessions.
Lectures will be used by the teachers to present the main concepts of the course.
Seminars will be mainly dedicated to interactive discussion with the students and to stress and clarify the most interesting and difficult points. Deliverable exercises and presentations will be done during the sessions.
Grading will be based on continuous evaluation (including a partial exam, practical sessions, and student participation in class and Aula Global) and a final exam. Help sessions and tutorial classes will be held prior to the final exam.
Attendance to lectures, short-exams or submission of possible homework is not compulsory. However, failure to attend any exam or submit the exercises before the deadline will result in a mark of 0 in the corresponding continuous evaluation block.
The practical sessions will consist on laboratory work. A laboratory report will be required. The attendance to practical sessions is mandatory. Failure to hand in the laboratory reports on time or unjustified lack of attendance will result in 0 marking for that continuous evaluation block.

ASSESSMENT SYSTEM

Grading:
Continuous evaluation: It accounts for up to 65% of the final score of the subject, and includes three components:
1) Partial exam (35% of the final mark): This exam will take place in a lecture session, will be announced at least 2 weeks in advance and will cover approximately half of the programme. If the grade is >=4.0, the students do not need to take the exam on this part in the final.
2) Practical sessions (20% of the final mark): They will be assessed through a laboratory notebook, laboratory reports and/or questionnaires that will be handed in at the end of each practical session. Attendance to at least 80% of the practical sessions is mandatory; otherwise the score will be 0 in this item.
3) Deliverable exercises, student participation and presentations in the seminar sessions (10% of the final mark): It includes exercises and homework (quizzes to be solved in groups or individually), other activities, and contribution in sessions.

Final exam: The final exam will cover the second part of the programme and will account for 35 % of the final score. Additionally, the students will have another opportunity to pass the exam on the first half. The minimum score in the final exam to pass the subject is 4.0 over 10, notwithstanding the mark obtained in continuous evaluation.

Extraordinary exams: The mark for students attending any extraordinary examination will be the maximum between:
a) 100% extraordinary exam mark, or
b) 50% extraordinary exam mark and 50% 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.

% end-of-term-examination:	35
% of continuous assessment (assigments, laboratory, practicals…):	65

BASIC BIBLIOGRAPHY

- J.G. Webster Medical Instrumentation Application and Design, John Wiley and Sons, Inc..
- L.A. Geddes and L.E. Baker Principles of Applied Biomedical Instrumentation, John Wiley and Sons, Inc..

ADDITIONAL BIBLIOGRAPHY

- A.F. Arbel Analog Signal Processing and Instrumentation, Cambridge University Press.
- J.B Olansen, E. Rosow Virtual Bio-Instrumentation, Prentice Hall PTR.
- L. Cromwell, F.J. Weibell, E.A. Pfeiffer Biomedical Instrumentation and Measurements, Prentice Hall Career & Technology.
- R. Sarpeshkar Ultra Low Power Bioelectronics, Cambridge University Press.