

BMED 3500 Biomedical Sensors and Instrumentation

Credit: 2-3-3

Prerequisite(s): ECE 3710

Catalog Description

A study of basic concepts, analysis, and design of electronic sensors and instrumentation used in biomedical measurements. Standard clinical measurement techniques will also be examined.

Text

Medical Device Technologies: A Systems Based Overview Using Engineering Standards, G. Baura, Academic Press, 2011

Objectives

The overall objective of this course is to introduce students to the basic principles and design issues of biomedical sensors and instrumentation, including: the physical principles of biomedical sensors, analysis of biomedical instrumentation systems, and the application-specific biomedical sensor and instrumentation design

Outcomes

By the end of the course the students will be able to:

1. classify systems modeling biomedical sensors and instrumentation
2. measure the static and dynamic characteristics of bioinstrumentation systems
3. design simple analog circuits (e.g. instrumentation amplifiers and active filters) used in bioinstrumentation
4. apply sampling theorem fundamentals to design and implement A/D conversion processes for biomedical signal acquisition
5. design and conduct experiments involving biomedical sensors and instrumentation as well as to measure and interpret experimental data from living systems
6. complete an open-ended team-based design project that will culminate in a poster presentation

Modality

Remote synchronous for the lectures. Online office hours will be available for consultations and demonstrations on/for the laboratory projects. Students will be provided with an electronics kit and loaned a National Instruments MyDAQ and breadboard for their lab projects.

Topical Outline

1. Representation of Systems
 - a) Forms of mathematical models
 - b) System classification
2. Bioinstrumentation Systems

- a) Basic Concepts & Characteristics
 - b) Single-Time Constant Circuits
 - c) Review of Op Amp Fundamentals
 - d) Signal Conditioning
 - e) Digital Signal Processing
- 3. Cardiovascular Devices
 - a) Electrocardiographs
 - b) Pacemakers
 - c) Defibrillators
 - d) Blood Pressure Monitors
 - 4. Neural Devices
 - a) Electroencephalographs
 - b) Deep Brain Stimulators
 - c) Cochlear Implants
 - d) Functional Electrical Stimulators

Laboratory Modules (Tentative)

- 1. Review of concepts and instrumentation
- 2. ECG amplifier design
- 3. Modeling and analysis of biopotential electrodes
- 4. Bandpass filters for EEG applications
- 5. Pressure Sensors for phonocardiogram (PCG) measurement
- 6. Design project