

EE-473/EE-573 Biomedical Instrumentation

Fall 2022-2023

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Catalog Data:

EE473/EE573 - Biomedical Instrumentation: Principles of biomedical transducers; amplifiers and signal processing; the origin, sensing and amplification of biopotentials; blood flow and pressure measurement; medical imaging, medical ultrasound and array signal processing; patient safety in medical instrumentation.

Textbooks:

- J. G. Webster, *Medical Instrumentation, 4e*, Wiley, 2009.
- A. Terry Bahill, *Bioengineering: Biomedical, Medical and Clinical Engineering*, Prentice Hall, 1981.

Computer Usage: Matlab (or a similar coding environment).

Prerequisites: Basic circuit theory, amplifier/filter design using op-amps.

Goals: The EE473/EE573 Biomedical Instrumentation course aims to give engineering skills on the origins, measurement, conditioning and processing of biological signals, with an emphasis on electronic circuit design.

Course Outline:

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| 1. The Origin of Biopotentials | (3 weeks) |
| 2. Sensors / Biopotential Electrodes | (2 weeks) |
| 3. Biopotential Amplifiers / Patient Isolation | (3 weeks) |
| 4. Measurement of ECG and EEG Signals | (2 weeks) |
| 5. Blood Pressure and Flow Measurements | (3 weeks) |
| 6. Medical Ultrasound and Beamforming | (1 weeks) |

Sample Laboratory and Project Work Topics (TBA during progression of course):

1. Simulation of Nerve Conduction
2. Basic ECG Measurement
3. Biopotential Amplifier Characterization
4. Circuit Design for Patient Isolation
5. Blood Flow Measurements
6. Image Reconstruction from Ultrasound Data

Grading: Midterm 30%; Lab work & Projects 35%; HWs 5%; Final 30%.

Make-up Policy: Make-up exams will be held after the final.

WARNING! Some of the experiments carried out in the course might require direct human contact to the designed hardware. In such cases, the equipment will be strictly BATTERY POWERED to avoid the risk of an electrical shock. As we are not qualified equipment manufacturers, even for circuits that have means for patient isolation, there is a risk. Consequently, students are strictly prohibited to experiment on themselves if the equipment has any kind of mains connection.