ECE/ME 4781 Biomedical Instrumentation (Elective)

Catalog Description: ECE/ME 4781 Biomedical Instrumentation (3-0-3)

Prerequisites: ECE 3030 Physical Foundations of Computer Engineering or ECE 3040 Microelectronic Circuits or ECE 3710 Circuits and Electronics

Crosslisted with BMED, CHBE, ECE, and ME.

A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered.

Textbook: John G. Webster, *Medical Instrumentation: Application and Design*, 4th Edition, John Wiley, 2009.

Topics Covered:

1. Basic concepts of instrumentation: static and dynamic characteristics, design criteria, instrumentation amplifiers.
2. Membrane biophysics: diffusion across cell membranes, Nernst potentials, diffusion potentials, Goldman equation.
3. Action potentials: membrane behavior, origin of action potential, Hodgkin-Huxley equations, modeling, propagation of action potentials, subthreshold stimuli.
4. Biopotential electrodes: fundamentals, body surface electrodes, microelectrodes.
5. Electrophysiology of the heart: anatomy/physiology of the heart, body surface potentials, electrocardiogram, heart vector, standard leads.
6. Electrophysiology of neuromuscular system: neuromuscular junction, transmitters, Poisson statistics for transmitters, postjunctional response, anatomy/physiology of muscle, myofibrils and filaments, excitation contraction, electromyography, functional neuromuscular stimulation.
7. Miscellaneous electrophysiology: electroencephalography, electroretinogram.
8. Biomedical transducers: displacement transducers, thermocouples and thermistors.
9. Measurement of blood and gas flows: electromagnetic flowmeter, ultrasonic flowmeter, thermodilution catheter.

Course Outcomes:

Outcome 1: To teach students the basic concepts of instrumentation, transducers, and the design of instrumentation systems in biomedical applications.

1.1 Students will be able to understand and use basic biomedical instrumentation.

1.2 Students will be able to design instrumentation systems for use with the body.

1.3 Students will have an understanding of the physics of various biomedical transducers, such as electrodes, displacement transducers, thermocouples, thermistors, and flow meters.

Outcome 2: To teach students the basics of membrane biophysics and its measurement in the body.

2.1 Students will understand the biophysics of cell membranes and how there are mathematically modeled.

2.2 Students will understand how electrodes are used and modeled to provide measurements of various potentials in the body.

Outcome 3: To teach students about biomedical measurements for various systems of the body.

3.1 Students will learn to measure and analyze data from the heart, the neuromuscular system, the brain, and the eye.

Correlation between Course Outcomes and Student Outcomes:

ME 4781											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X										X
Course Outcome 1.2	X		X		X						X
Course Outcome 1.3	X										X
Course Outcome 2.1	X				X						
Course Outcome 2.2	X				X						X
Course Outcome 3.1	X	X	X		X						X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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