ECE/ME 4782 Biosystems Analysis (Elective)

Catalog Description: ECE/ME 4782 Biosystems Analysis (3-0-3)

Prerequisites: BMED 3500 Sensors and Instrumentation or CHBE 4400 Chemical Process Control or ECE 2040 Circuit Analysis or ME 3017 System Dynamics

Crosslisted with BMED, CHBE, ECE, and ME.

Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems.

Textbook: Michael C. K. Khoo, *Physiological Control Systems: Analysis, Simulation, and Estimation*, Wiley-IEEE Press, 2001.

Topics Covered:

1. Fundamentals of digital signals and systems: convolution, Fourier transform, digital filters.
2. Fundamentals of probability and statistics: probability distribution and density functions, expectation and moments, random processes, white noise, correlation analysis, linear regression, examples of biostatistics; independence, dependence, genetic counseling, false alarm.
3. Modeling biological systems: models of systems and the modeling process, qualitative model formulation, quantitative model formulation, simulation paradigms, numerical techniques, parameter estimation, model validation, model analysis, stochastic models, nonlinear models.
4. Applications/examples: driver controlling speed of automobile, latency characteristics, pupil response, electroretinogram, adaptive noise cancelation, neural information processing.

Course Outcomes:

Outcome 1: To teach students the fundamentals of digital signal processing in biosystem applications.

1.1 Students will understand the signal chain for biosystems analysis problems, i.e., pre-processing, feature extraction, and classification.

1.2 Students will be able to design digital filters for physiological signals.

Outcome 2: To teach students the fundamentals of the cardiovascular system, its modeling, simulation, and measurement.

2.1 Students will understand the fundamentals of cardiovascular physiology.

2.2 Students will be able to analyze and interpret electrocardiogram signals, extract features, and classify abnormalities.

2.3 Students will be able to construct pressure volume loops for analyzing ventricular function.

Outcome 3: To provide student with the tools needed to critically analyze information and extract results from selected biosystem applications.

3.1 Students will be able to critically analyze and synthesize information from academic publications and industry patents in the area of biosystems analysis.

3.2 Students will be able to analyze and interpret electromyogram signals, extract features, and classify abnormalities.

3.3 Students will be able to analyze and interpret inertial measurement signals in the context of human activity monitoring.

3.4 Students will be able to explain the fundamentals of the body's thermoregulation processes.

Correlation between Course Outcomes and Student Outcomes:

ME 4782											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X										
Course Outcome 1.2	X		X		X						X
Course Outcome 2.1	X										
Course Outcome 2.2	X										
Course Outcome 2.3	X		X		X						X
Course Outcome 3.1	X				X				X		
Course Outcome 3.2	X				X						
Course Outcome 3.3	X				X						
Course Outcome 3.4	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

Prepared by: Omer Inan