Course Outline: Biomedical Signal Processing

Course number and title: ECE/BIOM 537
Credits: 3, 3 hours of lecture per week
Term(s): Spring 2009
Prerequisite(s): M 340 or ECE 311 or ST 303 or instructor approval.

Course Description:
This course in biomedical signal processing presents the relationships among different theoretical measures of biomedical signals and an understanding of the information these measures provide regarding the sources of signals and the behaviors of their sources in response to natural or imposed perturbations. Biomedical engineering involves the application of engineering methods for the improvement of human health; the signals encountered by biomedical engineers are typically derived from biological processes. Often such signals are not well represented by the simple deterministic signals favored for illustrating the basic principles of signal processing. Real – world biomedical signals usually include stochastic components. Therefore the biomedical engineering student must first recognize the range of possible signal types and be able to determine the most appropriate type of analysis for the signal of interest. By presenting signal processing as the process of developing and manipulating a model of the signal, this course develops the problems discussed above using an integrated framework. Four issues – (1) choosing a class of signal model, (2) selecting a specific form of the model, (3) evaluating indicators of adequacy of the model, and (4) subsequent processing are emphasized. This course is developed completely from a biomedical engineering perspective, so that measuring, manipulating and interpreting signals is fundamental to every practitioner of biomedical engineering, and that the concepts being presented are fundamental tools needed by all biomedical engineers. This course is taught at a level for first – semester graduate course in biomedical engineering or an advanced undergraduate course elective.

Instructor:
Prof V. Chandrasekar, Professor Department of Electrical Engineering and School of Biomedical Engineering

Text(s): Biomedical Signal Processing and Signal Modeling by Eugene N. Bruce
A Wiley-Interscience Publication **JOHN WILEY & SONS, INC.**
ISBN 0-471-34540-7

Learning Objective(s):
At the end of this course successful students will be able to:
1. Choosing a class of signal model,
2. Selecting a specific form of the model,
3. Process the signal

Course Topics/Weekly Schedule:

Week 1-2 The Nature of Biomedical Signals

What Is a Signal?
Some Typical Sources of Biomedical Signals
Continuous – Time and Discrete – Time
Why Do We "Process" Signals?
Types of Signals" Deterministic, Stochastic
Signal Modeling as a Framework for Signal Processing
What is Noise?

Week 3 Correlation
Energy and Power Signals
The Concept of Autocorrelation

Week 4 The Impulse Response

Week 5 Frequency Response
Biomedical Example
Ideal Filters
Frequency Response and Nonlinear Systems

Week 6 Responses of Linear Continuous –Time Filters to Arbitrary Inputs

Week 7 Discrete Time Modeling of Signals
Fourier Transform of Discrete-Time Signals
Sampling
The Discrete Fourier Transform (DFT)

Week 8 –9 Digital Filters
Week 10 Electrocardiography
Week 11 ECG QRS Detection
Week 12 ECG Analysis Systems
Week 13 Noise Removal and Signal Compensation
Week 14 Modeling Stochastic Signals
Week 15 Nonlinear Models of Signal
Week 16 - Final

Mode of Delivery:
This is a lecture course.

Methods of Evaluation:
Weekly Homework assignments (12 in total): 34%
Mid Semester Exam: 33%
Final Exam: 33%