051:182 Biomedical Signal Processing
Elective Course in the BME Biosystems/Bioimaging Focus Area
New course to be offered in Fall 2002

2002 Catalog Data: 051:182 Biomedical Signal Processing 4 s.h.

Description: Application of signal processing methods, such as Fourier, Laplace and z-transforms to biomedical problems, such as the analysis of cardiac signals, the circadian rhythm, and the breathing cycle. Includes computer simulation lab.

Textbook: Bruce, E.N. Biomedical Signal Processing and Signal Modeling, John Wiley and Sons, Inc., 2000. (ISBN 0-471-34540-7)

Coordinator: Oguz Poroy, Biomedical Engineering

General Goals: The goal of this course is to educate the students in the application of signal processing methods to biomedical systems. Signal processing concepts are introduced using real-life biomedical examples. The students learn how to solve problems embedded in these examples by the application of the newly introduced concepts. Another objective is to teach the students how to use a computer workstation as part of a measurement/signal-processing system. This is accomplished in the laboratory, where students work with MATLAB simulations of the examples discussed in class.

Specific Course Goals:
1. The student will have an understanding of linear system theory;
2. The student will have an understanding of transfer functions and state models;
3. The student will have an understanding of time-domain and frequency-domain models;
4. The student will have an understanding of the concept of signal filtering;
5. The student will develop the skill to model complex biomedical systems;
6. The student will learn to use signal processing methods to analyze signals originating in biomedical systems;
7. The student will have the opportunity to further his professional development through using modern computing tools;

Prerequisites by topic:
Physiology
Chemistry, physics
Integral calculus, differential equations
Linear system theory

Pre-requisites/Co-requisites by Course:
Pre-requisites: 051:080 Bioelectrical Design

Topics (Class Hours):

Nature of Biomedical Signals	(2)
Memory and Correlation	(2)
Impulse Response	(4)
Frequency Response	(3)
Fourier Series and Transform	(4)
Laplace Transform	(3)
Discrete-time Fourier Series and Transform	(4)
Noise Removal and Signal Compensation	(6)
Modeling Stochastic Signals	(5)
Scaling and Long-term Memory	(3)
Nonlinear Models of Signals	(5)
Stationarity and Reproducibility	(4)
Total	(45)

Computer Usage: Substantial computer simulations with MATLAB; programming & graphing using data collected from real-life biomedical systems.

Laboratory Projects: The student prepares formal laboratory reports on experiments conducted in the Biosystems/Biomeasurements Laboratory.

Contribution to Criterion 4 "Professional component":

_	Mathematics and Basic Sciences
x	Engineering Science
x	Engineering Design
_	General Education
x	Other (e.g., elective)

Course Outcomes Worksheet (COW)

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Last modified on February 27th, 2002, by Oguz Poroy

Specific Course Goals	Supports BME Outcomes	Course Activity	Basis for Specific Course-Goal Assessment
1. The student will have an understanding of linear system theory;	**1 (●), 2 (●), 4 (●), 7 (○)**	Homework and exams exercise and test the students' abilities in these areas. Open-ended problems requiring an understanding of linear systems will be given.	EASY survey assessment by students and instructor; graded copies of selected homework and exam questions*.
2. The student will have an understanding of transfer functions and state models;	**1 (●), 2 (●), 4 (●), 7 (○)**	Homework and exams exercise and test the students' abilities in these areas. Open-ended problems requiring an understanding of transfer functions and state models will be given.	EASY survey assessment by students and instructor; graded copies of selected homework and exam questions*.
3. The student will have an understanding of time-domain and frequency-domain models;	**1 (●), 2 (●), 4 (●), 7 (○)**	Homework and exams exercise and test the students' abilities in these areas. Open-ended problems requiring an understanding of time-domain and frequency-domain models will be given.	EASY survey assessment by students and instructor; graded copies of selected homework and exam questions*.
4. The student will have an understanding of the concept of signal filtering;	**1 (●), 2 (●), 4 (●), 7 (○)**	Homework and exams exercise and test the students' abilities in these areas. Open-ended problems requiring an understanding of signal filtering will be given.	EASY survey assessment by students and instructor; graded copies of selected homework and exam questions*.
5. The student will develop the skill to model complex biomedical systems;	**1 (●), 2 (●), 3 (●), 4 (●), 7 (●)**	In the laboratory, students will develop MATLAB models of complex biomedical systems. They will work independently to complete their projects and prepare a laboratory report.	EASY survey assessment by students and instructor; writing guidelines handout; graded copies of laboratory reports*
6. The student will learn to use signal processing methods to analyze signals originating in biomedical systems;	**1 (●), 2 (●), 3 (●), 4 (●), 7 (●)**	In the laboratory, students will apply the concepts discussed in lectures to signals in the MATLAB models of biomedical systems. They will work independently to complete their projects and prepare a laboratory report.	EASY survey assessment by students and instructor; assignment handouts; graded copies of laboratory reports*
7. The student will have the opportunity to further his professional development through using modern computing tools;	**1 (●), 2 (●), 4 (●), 7 (●)**	Students will develop substantial computer programs (using MATLAB) to model biomedical systems.	EASY survey assessment by students and instructor; examples of system- and process-models developed by students.

○ denotes moderate contribution to the outcome ● denotes substantial contribution to the outcome

***** One high score and one low score will be collected with the remainder of the sample a random selection.

Prepared by: Oguz Poroy Date: 27 February 2002