BME140 DESIGN OF BIOMEDICAL ELECTRONICS

Catalog Data: **BME140 Design of Biomedical Electronics (Credit Units: 4) W.** Analog and digital circuits in bioinstrumentation. Biomedical signals in continuous and discrete systems. Sampling and digital signal processing. MRI, CT, ultrasound, bioelectromagnetics, electrokinetics. Applications to bioengineering design. Prerequisite: BME130. (Design units: 3)

Textbook: *Medical Instrumentation: Application and Design,* Webster, J. G. (ed.). 3rd edition, John Wiley & Sons. 1998.

References: Wolf, Stanley and Smith Richard F. M., *Student Reference Manual for Electronic Instrumentation Laboratories*. 2nd edition. Prentice Hall.
Horowitz and Winfield, *The Art of Electronics*. 2nd edition. Cambridge University Press. 1989.
Class handouts.

Coordinator: Zhongping Chen.

Course Outcomes: Students will be able to:
Analyze DC and AC circuits that consist of resistors and capacitors.
Design and construct low pass, high pass, and band pass filters.
Design and construct amplifier with operational amplifier.
Use electrical measurement instruments such as multimeter, function generator, oscilloscope, and Labview ELVIS stations to acquire measurement data.
Describe the origin and characteristics of bioelectrical signal, including resting potential and action potential.
Describe the heart electrical circuit and EKG signal.
Explain the design and construction of EKG instruments.
Explain the safety issues involved in bioelectrical measurement and medical instrumentation.
Measure and analyze EKG signals.

Prerequisites By Topic: Introductory physics and physics laboratory.

Lecture Topics: Analog and digital circuits in bioinstrumentation.
AC and DC circuit, filter, operational amplifier, amplifier and filter design using operational amplifier.
Bioelectrical signal, bioelectrode, EKG signal.
Biomedical signals in continuous and discrete systems, A/D conversion and data acquisition.
Noise and electrical interference in bioelectrical signal, electrical safety.

Class Schedule: Each class meets 3 hours per week for 10 weeks and students are assigned to a 3 hour lab session per week and a 1 hour discussion session per week.

Computer Usage: Students will use basic compute skills to solve homework problems and prepare design reports (MSWord and Excel).

Laboratory Projects: There will be six Laboratory exercises:
Basic instrumentation for electrical instruments and measurement theory.
Labview and Educational Laboratory Virtual Instrumentation Suite
Operational amplifiers.
AC circuit and Filter
EKG Instruments.
EKG signal measurement.

Professional Component: Contributes toward the Biomedical Engineering Topics and Major Design experience.

Relationship to Program Outcomes: This course relates to Program Outcomes 1 and 2 as stated at: http://www.eng.uci.edu/dept/objective_biomedical.

Design Content Description

Approach: Describe the origin and characteristics of bioelectrical signals including the amplitude and frequency range; discuss the noise and interference from AC power line and other sources; discuss the design criteria and strategy to optimize the device performance. (40%) Design an EKG amplifier to be used for measuring EKG signal. (30%) The aim of the laboratory exercises is to teach students the basic skills in the design of amplifiers, filters, feedback, instrument control and signal sampling, as well as their application for measuring bioelectrical signals. Students will construct an EKG device and use it to measure EKG signal. (30%)

Lectures: 40%

Laboratory Portion: 60%

Grading Criteria:

Homework problems:	20%
Laboratory	30%
Midterm:	20%
Final:	30%
	100%

Estimated ABET Category Content:

Mathematics and Basic Science: 0 credit units or 0%
Engineering Science: 1 credit units or 25%
Engineering Design: 3 credit units or 75%

Prepared by: Zhongping Chen **Date:** July 2005

CEP Approved: Fall 2004