BME140 DESIGN OF BIOMEDICAL ELECTRONICS
(Required for BME)

Catalog Data: **BME140 Design of Biomedical Electronics (Credit Units: 4)** Analog and digital circuits in bioinstrumentation. AC and DC circuit analysis, design and construction of filter and amplifiers using operational amplifier, digitization of signal and data acquisition, bioelectrical signal, design and construction of ECG instrument, bioelectrical signal measurement and analysis. 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.
Other handouts supplied

Coordinator: Zhongping Chen

Relationship to Program Outcomes: This course relates to the Program Outcomes for **BME:** a and b as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/biomedical/mission

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

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, ECG 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: Meets for 3 hours of lecture, 3 hours of lab each week for 10 weeks.

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.
ECG Instruments.
ECG signal measurement.

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

Design Content Description

Approach: Design an ECG amplifier to be used for measuring ECG signal. (30%) 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%) 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 ECG device and use it to measure ECG signal. (30%)
Lectures: 70%
Laboratory Portion: 30%

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 2008

CEP Approved: Winter 2006