COURSE OUTLINE

ELEC 436 – BIOMEDICAL ELECTRONICS

Prepared By: Dr. Rashid Aidun

SCHOOL OF ENGINEERING TECHNOLOGY
ENGINEERING SCIENCE & ELECTRICAL ENGINEERING TECHNOLOGY DEPARTMENT

May 2015
A. **TITLE**: BIOMEDICAL ELECTRONICS

B. **COURSE NUMBER**: ELEC 436

C. **CREDIT HOURS**: 3

D. **WRITING INTENSIVE COURSE**: NO

E. **COURSE LENGTH**: 15 weeks

F. **SEMESTER OFFERED**: FALL

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY**: 2- Hours Lecture and 2- Hours Laboratory per week

H. **CATALOG DESCRIPTION**: This course is designed to give students theoretical and hands-on experience in biomedical instrumentation and measurement. Topics covered include: Medical Instrument Transducers, Bio-potential Amplifiers, The pacemaker, Ultrasonic Equipment, Central Station Monitor, Electroencephalograph and Filtering, Electrosurgical Units and Laser Surgery, and Catheters and Blood Pressure Monitoring Devices.

I. **PRE-REQUISITES/CO-COURSES**: ELEC 416 [Microelectronics Circuit Design] and MATH 162 [Calculus II], or permission of instructor.

J. **GOALS (STUDENT LEARNING OUTCOMES)**:

By the end of this course, the student will be able to:

a. Solve problems that arise with complex medical equipment.
b. Design and modify basic medical electronic instrument.
c. Apply the knowledge of Op-Amps in the design process.
d. Construct and test electronic circuits used in medical equipment.

<table>
<thead>
<tr>
<th>Course Objectives</th>
<th>Institutional SLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Solve problems that arise with complex medical equipment.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>b. Design and modify basic medical electronic instrument</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>c. Apply the knowledge of Op-Amps in the design process</td>
<td>3. Professional Competence</td>
</tr>
<tr>
<td>d. Construct and test electronic circuits used in medical equipment.</td>
<td>3. Professional Competence</td>
</tr>
</tbody>
</table>

K. **TEXTS**: 
L. REFERENCES:

M. EQUIPMENT: Students need to purchase laboratory components kit. (Basic test instruments will be identified and purchased).

N. GRADING METHOD: A-F

O. MEASUREMENT CRITERIA/METHODS:
- Exams
- Laboratory projects
- Participation
- Presentation

P. DETAILED TOPICAL OUTLINE:

1. Basic Theories of Measurement
   a. Categories of Measurement
   b. Factors in Making Measurements
   c. Measurement Errors
   d. Categories of Errors
   e. Dealing with Measurement Errors
   f. Error Contribution Analysis

2. Electrodes, Sensors, and Transducers
   a. Signal Acquisition
   b. Transduction
   c. Tactics and Signals Processing for Improved Sensing
   d. Medical Surface Electrodes
   e. Microelectrodes
   f. Strain Gauges
   g. Quartz Pressure Sensors
   h. Matching Sensors to Circuits
   i. Temperature, Capacitive, and Inductive Transducers

3. Bioelectric Amplifiers
   a. Multiple-Input Circuits
   b. Signal Processing Circuits
   c. Practical Op-Amps
   d. Isolation Amplifiers
   e. Chopper Stabilized Amplifiers
   f. Input Guarding

4. Electrocardiographs
   a. The Heart as a Potential Source
b. The ECG Waveform
c. The Standard Lead System
d. Other ECG Signals
e. The ECG Preamplifier
f. ECG Readout Devices
g. ECG Machines
h. ECG Maintenance/Troubleshooting

5. Physiological Pressure and Other Cardiovascular Measurements and Devices
   a. Physiological Pressures
   b. Pressure Measurements
   c. Blood Pressure Measurements
d. Oscillometric and Ultrasonic Noninvasive Pressure Measurements
e. Pressure Amplifier Designs
f. Ac Carrier Amplifiers
g. Systolic, Diastolic, and Mean Detector Circuits
h. Pressure Differentiation (dP/dT) Circuits
i. Practical Problems in Pressure Monitoring
j. Step-Function Frequency Response Test
k. Defibrillator Circuits
l. Pacemakers

6. Medical Ultrasonography
   a. Ultrasound Transducers
   b. Absorption and Attenuation of Ultrasound Energy
c. Biological Effects of Ultrasound
d. Doppler Effect
e. Transcutaneous Doppler Flow Detector
f. Flowmeters
g. Ultrasonic Blood Pressure Measurement

Q. LABORATORY OUTLINE (As projects):

1. Electrode Model Circuit
2. Quartz Pressure Sensor Oscillator
3. Ac-coupled Programmable-gain Instrumentation Amplifier (PGIA)
4. ECG Amplifier
5. Electrosurgery Unit Interference Filter
6. Systolic Detector Circuit
7. Photoplethysmograph Circuit
8. Cardiotachometer Circuit
9. Electrosurgery Tester
10. Photometer Calibration Circuit