STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

MASTER SYLLABUS

ELEC 436 – BIOMEDICAL ELECTRONICS

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SCHOOL OF ENGINEERING TECHNOLOGY
ELECTRICAL ENGINEERING TECHNOLOGY & ENGINEERING SCIENCE DEPARTMENT

February 2019

A. **TITLE :** BIOMEDICAL ELECTRONICS

B. **COURSE NUMBER:** ELEC 436

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 3
 # Lecture Hours: 2 **per week**
 # Lab Hours: 2 **per week**
Other: per week

Course Length: 15 **Weeks**

D. !**WRITING INTENSIVE COURSE:** NO

E. !**GER CATEGORY: NONE**

F. !**SEMESTER OFFERED:** FALL/SPRING

G. !**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.

H. !**PRE-REQUISITES:** ELEC 416 [Microelectronics Circuit Design] and MATH 162 [Calculus II], or permission of instructor.

CO-REQUISITES: NONE

I. ! **STUDENT LEARNING OUTCOMES:**

- Institutional Student Learning Outcomes (ISLO)
- Accreditation Board for Engineering and Technology (ABET) – Student Outcomes

Course Objectives	Institutional SLO	ABET- Student Outcomes
a. Solve problems that arise with complex medical equipment.	2. Critical Thinking	1. An ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems appropriate to the discipline.
b. Design and modify basic medical	2. Critical Thinking	1. An ability to apply knowledge, techniques, skills and modern tools of

electronic instrument		mathematics, science, engineering, and technology to solve broadly defined engineering problems appropriate to the discipline.
c. Apply the knowledge of Op-Amps in the design process	5. Industry, Professional, Discipline-Specific Knowledge and Skills	1. An ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems appropriate to the discipline.
d. Construct and test electronic circuits used in medical equipment.	5. Industry, Professional, Discipline-Specific Knowledge and Skills	2. An ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline. 4. An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the result to improve processes.

J. **APPLIED LEARNING COMPONENT:**

Classroom/Lab

K. **TEXTS:**
Principles of Biomedical Instrumentation and Measurements, Richard Aston, ISBN: 0-675-20943-9, Maxwell Macmillan International Publishing Company

L. **REFERENCES:**
Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment and Technology, 4thEdition. Upper Saddle River, New Jersey: Prentice-Hall, 2001.

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

N. ! **GRADING METHOD:** A-F

O. **SUGGESTED 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. <u>LABORATORY OUTLINE (As projects)</u>:

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