**TO:** The Engineering Faculty

**FROM:** The Faculty of the Department of Biomedical Engineering

**RE:** New Undergraduate-Level Course

The faculty of the Department of Biomedical Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

## BME 305 Bioinstrumentation Laboratory

Sem. 1. Class 1, Lab 3, cr. 2

Prerequisites: PHYS 241, MA 266, or equivalent
Co-requisite: BME 301

Introduction of laboratory instruments used to measure physiological events. Stimulation and conduction of electrical signals within the mammalian nervous system and other excitable tissues are demonstrated. Fundamental circuit elements and concepts include resistance, capacitance, inductance, op-amps, impedance, voltage, current, power, and frequency. Integrative design project addresses instrumentation amplifiers and filtering for obtaining an ECG, emphasizing the practical aspects of quantitative physiological measurements.

**Reason:** Laboratory experiences where students learn fundamental instrumentation concepts and measurement techniques for monitoring and quantifying aspects related to physiological events. This course ensures an understanding of the criteria for faithful reproduction of physiological events, which is an essential skill for practicing biomedical engineers.

George Wodicka
Professor and Head

## Supporting Documentation:

1. Level: Undergraduate – junior year

2. Course Instructors: Ann Rundell

3. Course Outline:

Lecture / Lab 1: Introduction to basic circuit elements, concepts, and safety: resistance (R), impedance, voltage, current, power, voltmeters, ammeters, breadboards, voltage and current laws
Lecture / Lab 2: Basic nodal and mesh analysis, superposition, linearity, time varying signals and oscilloscopes
Lecture / Lab 3: Capacitors (C) and inductors (L), RC and RL step responses
Lecture / Lab 4: Steady state sinusoidal responses of RC and RL circuits
Lecture / Lab 5: Frequency response of linear circuits, labview primer
Week 6: **Exam I**
Lab 6: Circuit analysis in the s-domain, filters, frequency and time signal responses
Lecture / Lab 7: RLC circuits
Lecture / Lab 8: Bioelectrodes
Lecture / Lab 9: Pneumotachometer and respiratory parameters
Lecture / Lab 10: Single and compound action potentials, all-or-none and graded responses
Lecture / Lab 11: Stimulation of excitable tissue
Week 12: **Exam II**
Lab 12: Nerve signal propagation velocity
Lecture / Lab 13: Operational amplifiers, differential amplifiers, and common mode rejection ratio
Lecture / Lab 14: Design of instrumentation amplifier and mapping out the dipole field using ECG tank
Lecture / Lab 15: Recording of the ECG with electrodes and designed instrumentation amplifiers
Week 16: **Cumulative Final Exam**

4. Text: *Engineering Circuit Analysis*, W.H. Hayt Jr., J.E. Kemmerly, S.M. Durbin, McGraw-Hill, 6/ed., 2002. Supplemental: *Principles of Applied Biomedical Instrumentation* L.A. Geddes and L.E. Baker, Wiley Interscience, 3/ed., 1989. Laboratory manual prepared by the instructors and technical staff.

5. Grading:

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| Pre-laboratory assignments | 5% |
| Laboratory quizzes | 15% |
| Weekly laboratory assignments | 25% |
| Exams | 30% |
| Cumulative final | 25% |