SCHOOL OF ENGINEERING
UNIVERSITY OF GUELPH

Course Description and Outline 2008

Course No.	Name	Semester	Hours
ENGG*4390	**Bio-instrumentation Design**	Fall	3-2 (0.75)

Prerequisites: ENGG*3450

Faculty: G.L. Hayward, Room 2339, Thornbrough Building, Ext. 3644.
Teaching Assistant: Albert Brooks, Room 320, Thornbrough Building

Calendar Description:

Theory and selection criteria of devices used in measurements in biological systems; design of complete measurement systems including transducers, signal conditioning and recording components; error analysis. Differences between measurements in biological and physical systems.

Learning Objectives:
Students who successfully complete this course will be able to:

a) Describe measurement devices for the determination of important factors that characterize biological systems or physical and chemical factors that have a profound effect on biological entities.
b) Quantify the limitations of bio-instrumentation systems through error analysis.
c) Design a complete instrumentation system, including the transducer, signal conditioning and recording stages to resolve particular measurement problems related to biological systems.

Textbook:

The text for this course is 'Practical Interfacing in the Laboratory' by Stephen E. Derenzo, Cambridge University Press, 2003, ISBN 0-521-81527-4). It covers many of the basics, including a good review of electronics and some of the math involved in signal processing. **READ IT.** If you read and understand it, you will almost certainly pass the course. There are a lot of other references that can be used as well. It will be well worth the time to dig them out.

The lecture material will be drawn from other sources to supplement the text. I don't intend to repeat the text orally. The field of instrumentation covers most of the areas of engineering, so my approach will aim at the methodology and tools rather than creating a cookbook full of miscellaneous facts. Measurement problems tend to share the fundamentals, but the applications are almost always unique.

ASK QUESTIONS. This is the best way to dissect the approach to instrument problems. A lot is now intuitive to me, and questions are the best way to make sure you see all the steps involved in analyzing a problem and synthesizing a solution. If you were to ask me for a solution to an instrument problem, I will always ask a lot of questions and each one usually makes the ultimate solution simpler.

Laboratory:

The laboratory part of this course will consist of the evaluation of two instruments carried out by groups of 2 students. There are a variety of sensors available in the lab, but others can be scrounged, so if the one you have a particular interest in is not in the initial selection, consult with the instructor. Since this is an advanced level design course, you will prepare a proposal for each laboratory outlining the approach to be taken and the laboratory equipment requirements. This makes the labs more unstructured, but the rewards are great. **ONLY** when your proposal is approved by the instructor, can you carry out the experiments during the assigned laboratory periods and at other times by arrangement with Ms. H. Ma, the technician in charge of the electrical laboratory. This will, of course, be subject to prior lab bookings and any safety concerns. Safety aspects **MUST** be addressed in the laboratory proposals, but not in the final reports. More details will be found in the lab handout.

Design Project:

The project will consist of the preliminary design of an instrument system to carry out the measurement(s) required to solve a biological problem to be chosen by you in consultation with the instructor. The report will include a problem statement and the design, with justification for the component choices. The system will not be constructed so the report may be more of a feasibility estimate. The design project will be carried out by **individual** students.

Evaluation:

Problem Assignments	15%
Lab Reports	40%
Design Project	15%
Final Exam	30%

Notes:

- Please refer to the calendar regarding academic misconduct. The School is operating on a zero-tolerance policy in these matters.
- The laboratory reports will be graded for both their technical content and for their grammar and writing style.
- Safety in the laboratory is a prime concern. Lab proposals must include a safety section. Proper personal protection such as gloves and goggles must be worn, depending on the experiment. The University policy forbidding working alone will also be strictly enforced.

05-439 Material To Be Covered:

Introduction to Instrumentation and Measurement
Sensors, Transducers and Electrodes
High Impedance Differential Amplifiers
Signals and Noise
Data Conversion and Transmission
Electromagnetic Compatibility
Electrical Safety in a Medical Environment

Thermal Measurements
Force, Strain and Weight Measurements
Fluid System Measurements
Displacement and Position Measurements
Optical Measurements
Chemical Composition Measurements
Biopotential Measurements

Other Measurement Systems if time permits