ELEC 4709A Integrated Sensors Fall 2020

Instructor: Niall Tait, Niall.Tait@carleton.ca

Teaching assistant: TBD

Grading:

Labs	40%
Quizzes	30%
Final exam	30%

The final exam is for evaluation purposes only and will not be returned to the student.

Satisfactory performance during the term requires completion of all lab experiments and a combined average grade of >40% on lab reports and quizzes.

The final exam must be completed with a minimum grade of 40% to pass the course.

Course Web Site: http://culearn.carleton.ca

Health and Safety: See https://carleton.ca/ehs/programs/working-lab/laboratory-health-and-safety/ for general guidelines. This fall labs will be completed remotely, however students should be aware of potential risks.

Labs: Labs are intended to provide practical experience in working with integrated sensors. Labs typically require design and simulation of simple circuits, sensor measurements, and analysis. One lab will also use finite element numerical analysis (FEA) software (COMSOL) in the design of an integrated sensor.

Lab instructions will be available on the course web page. In most cases design work is required prior to attending the lab. Most labs require circuit simulation using **NI Multisim**. When possible results will be verified by experimental measurements completed through a **remote connection to a lab station**.

Labs will include:

1. Making accurate measurements using common lab equipment
2. Characterization of a piezoresistive pressure sensor
3. Analysis and simulation of a pressure sensor
4. Oscillometric blood pressure measurement
5. Temperature sensor data acquisition
6. Optical signal generation and sensing

Outline:

The emphasis in the course will on sensors that can be integrated in silicon technology, including principles of operation and application examples. There will also be some fundamental material on dealing with low signal levels in the presence of noise, as this problem is often encountered in working with sensors. Sensors for consumer, biomedical and industrial applications will be considered. Specific topics include:

1. Measurement principles; uncertainty, precision and accuracy
2. Signals and interfaces
3. Fabrication technologies for silicon ICs and sensors; micromachining
4. Mechanical sensors (strain and pressure)
5. Temperature sensors
6. Sensors for visible and infrared radiation, including imagers
7. Sensors for ionizing radiation (x-rays, gamma rays, etc.)
8. Magnetic sensors
9. Chemical sensors
10. Selected topics (to be determined)

Students requiring academic accommodation please refer to the Carleton Equity Services web site:
https://students.carleton.ca/services/accommodation/

Textbook: (not compulsory)

Handbook of Modern Sensors, 4th Edition, Jacob Fraden, Springer 2010, ISBN 978-1-4419-6465-6
Electronic resource:
https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/1gorbd6/alma991022634465205153

Sensors and Signal Conditioning, 2nd Edition, Ramon Pallas-Areny and John G. Webster, Wiley Interscience, 2001. ISBN: 0471332321

Course Learning Objectives:

On successful completion of the course, a student is expected to be able:

1. To understand integrated sensor specification and selection.

2. To appreciate the process of designing sensor elements.

3. To design signal conditioning circuitry suitable for interfacing sensor output with digital or analog readout or data logging.

4. To identify and resolve sources of noise and signal artifacts in sensor measurements.

5. To relate sensor signals to physical quantities of interest.