Carleton University
Department of Electronics

EGEN 5303: Sensor Systems Fall 2025

Course schedule:

Lecture Tue/Thu 11:35-12:55 ME4236

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

Course description:

Calendar description - *Advanced topics dealing with technologies, transduction mechanisms, and fabricated sensors and actuators. Sensors for acceleration, rotation rate, pressure, and different micro actuators with application microfluidics, chemical, gas, and biosensors.*

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:

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

Project Deliverables

To reflect graduate professional expectations, students complete a project with deliverables that integrate technical analysis with application-oriented engineering judgment. These deliverables build on the course lecture content.

Project deliverables will be described in a separate document and will include:

- Application proposal
- Engineering requirements document
- Design strategy proposal
- Detailed design
- Final report and presentation

As part of the final reporting requirement, students will be required to give a 5 minute technical presentation that summarizes the design exercise for a target audience of technical peers and engineering managers.

Health and Safety:

This course does not have a formal lab component, but we may take class time for demonstrations and hands-on activities. Respecting lab safety precautions and following directions of lab staff is essential to keep everyone safe.

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

General lab safety precautions can be found at

https://carleton.ca/ehs/programs/working-lab/laboratory-health-and-safety/

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

- To understand integrated sensor specification and selection.
- To explain the process of physical design of a sensor element.
- To design signal conditioning circuitry suitable for interfacing sensor output with digital or analog readout or data logging.
- To identify and resolve sources of noise and signal artifacts in sensor measurements.
- To relate sensor signals to physical quantities of interest.

Precluded courses: none

Prerequisites: Enrolment in the M.Eng.- Engineering Practice program and an undergraduate degree in Electrical Engineering or permission of the Director. The course assumes some knowledge of circuits and signals including passive DC and AC circuit analysis, simple filters, transistor and op-amp circuits normally covered in core undergraduate EE curriculum.

Textbooks: Students are not required to purchase textbooks or other learning materials for this course. These are suggested references only, available as online resources.

Handbook of Modern Sensors, 4th Edition, Jacob Fraden, Springer 2010, ISBN 978-1-4419-6465-6
Electronic resource through Carleton Library

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

Evaluation :

Project	30%	
Quizzes (2)	20%	October 2, November 6
Final exam	50%	

Additional requirements – Satisfactory performance during the term requires completion of all project components and a combined average grade of >40% on project and quizzes.

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

Quizzes – Quizzes are in-person long-answer papers scheduled during class time on the dates above.

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

Students who are unable to write the final examination due to serious illness, emergency or other circumstances beyond their control may apply for accommodation by contact the Registrar's office. Consult Section 9.3 of the academic regulations in the University graduate calendar.

Missed term work - Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor. In all cases this must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult Section 9.4 of the academic regulations in the University graduate calendar.

Generative Artificial Intelligence (AI): Use of generative AI tools (such as ChatGPT) can serve you as a valuable learning tool. However like any reference source, AI generated material should be properly cited. Claiming AI generated material as your own is a violation of academic integrity. You are accountable for your work, and if you simply parrot AI output it becomes a crutch and not a learning tool.

You must be able to criticize or defend output you generate with AI. Exams are intended to assess your individual understanding and competency in the subject, AI tools will not be available to you in your exams.

Academic integrity and plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: https://carleton.ca/engineering-design/current-students/fed-academic-integrity
Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that the work you submit is your own. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source.
Examples of violations of the policy include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
- using another's data or research findings without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotation marks.

Advising and Counselling services

a) Engineering Academic Advising

The Engineering Academic Support Service : https://carleton.ca/engineering-design/current-students/undergrad-academic-support/ assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.
Academic advisors contact information: https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/

b) Student Mental Health Service

As a University student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need to talk to someone, please reach out for assistance: Wellness - Current Students - Carleton University.

Learning and working environment

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities | Carleton University.
We strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

Academic Accommodation

a) Carleton University is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the *Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances*, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).