Carleton University

Department of Electronics

Summer 2025

ECOR 1044: Mechatronics

Introduction

In this course you will learn the fundamentals of mechatronics and its many applications especially Raspberry Pi, sensors, motors, and actuators. Laboratories will reinforce understanding of operating characteristics of Raspberry Pi, sensors and motors.

Course Description and Requirements

Mechatronics applications. Introduction to Raspberry Pi and Basic Coding in Python. Input devices, including sensors. Data collection and processing. Output devices, including displays, actuators, and motors. Analog to digital signal conversion. Control systems and PID controllers. Project design and economics. Environmental Impact of Mechatronic Engineering. System failures and failsafe design. Introduction to Robotics and Microcontrollers.
Includes: Experiential Learning Activity
Prerequisite(s):
- ECOR 1041 and ECOR 1043 with a minimum grade of C-.
- This course may not be taken concurrently with ESLA 1300 or ESLA 1500.
Lectures 3 hours per week.
Laboratory 3 hours per week.

Instructor

Mohamad Hasheminasab, CB 3303
Email: seyedmohammad.hasheminasab@carleton.ca
Head TA: Masood Nekoei, masoodnekoei@cmail.carleton.ca
Course Webpage: on Brightspace

Textbook

1) Lecture notes are provided on Brightspace

2) Recommended (but not necessary) textbook: none.

Lecture Outline

ECOR 1044 – Azrieli Theatre 302, Tuesday & Thursday: 16:05 – 17:25 PM – In person
The following topics will be covered during the course lectures with an approximate schedule.

Week 1: Introduction
Week 2: Raspberry PI; I/O Devices
Week 3: Boolean Logic; A/D Conversion
Week 4: DeMorgan's Laws; Automation and Control
Week 5: PID Control; Workshop
Week 6: Design Process; Product Life Cycle; Robotics and Safety
Week 7: Review

Laboratory

3 hours per week

Notes for Labs

- There are four labs as follows:
  - Lab 1: LED- Buzzer, DC motor
  - Lab 2: PWM, Servo motor, Ultrasonic sensor
  - Lab 3: Stepper motor, LCD
  - Lab 4 (Project): Mobile robot

- Labs are 3 hours in duration and will be held in Canal Building (CB) 4301. A TA will take attendance at each lab session.

- If for some reason a Lab needs to be rescheduled OR a Lab falls on one of the University holidays, students in those sections must try to rearrange their schedule to make up the lab in another of the regularly scheduled lab sessions, as arranged by the instructor.

- Attend each lab punctually. Be prepared for the lab experiment by reading the lab instruction sheets before entering the lab.

- A lab report will be submitted online for each lab and by each student. Refer to General Instructions for Labs and Final Project document to write the lab/project report. The deadline of the lab reports is set on the Brightspace Dropbox. Late lab reports must still be submitted. One day late it will only be worth 50%. Two days late, it is worth 0.

Self-Declaration form and Deferred 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 submitting a self-declaration form no later than three (3) days after the date/deadline of term work including test/midterm, labs, assignments. Any alternate arrangements made with the instructor for submission of term work should be made as soon as possible but within 3 days of the missed due date. If this is not possible after discussion with the instructor, alternate arrangements must be made before the last day of classes in the term as published in the academic schedule.

Evaluation and Grading Scheme

The cumulative course grade will be determined as follows:

- 60% Final Exam on campus during normal scheduled exam period. Final exams are for evaluation purposes only and will not be returned to the student.
- 30% Laboratories and you must complete and submit all lab reports on due date and time.
- 10% Project and you must complete and submit the report on due date and time.

To pass the course you need:

- Minimum overall grade of C-
- Have completed all labs and submitted all lab reports, plus the project.
- No minimum passing grade on the final exam.
- Grades will be assigned based on the criteria listed above ONLY and converted into a letter grade as defined in the Carleton Course Calendar.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Interact with electrical hardware such as sensors, motors, and other devices to integrate them into a simple system.
2. Analyze analog to digital signal conversion, and control systems to solve basic problems.
3. Apply the engineering design process to improve upon a simple system.
4. Integrate the various lab components in the project design.
5. Generate a project report based on the findings of the project lab experiment.

Graduate Attributes

The Canadian Engineering Accreditation Board requires graduates of undergraduate engineering programs to possess 12 attributes: Graduate-Attributes.pdf (engineerscanada.ca) or GA's. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's year-to-year progression through the program or eligibility to graduate. Accreditation metrics are based on courses common to all students in a program.

This following list provides the GAs that will be measured in this course, along with the indicators that are intended to develop and assess these attributes.

Graduate Attribute		**Indicators**
1. A knowledge base for Engineering	Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	1. Digital circuits 2. Computer software and hardware
2. Problem Analysis	An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.	1. Problem definition 2. Approach to the problem 3. Use of assumptions 4. Interpreting the solution, validity of results

4. Engineering Design	An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.	1. Clear design goals 2. Detailed design specifications and requirements 3. Design solution(s) 4. Design implementation, task(s) definition 5. Alternate solution(s) definition 6. Evaluation based on engineering principles
5. Engineering Tools	An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.	1. Tools for design, experimentation, simulation, visualization and analysis
6. Individual and Team work	An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.	1. Personal and group time management 2. Group culture, group dynamics
9. Impact on Society and Environment	An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.	1. Sustainable design; life-cycle planning
11. Economics and Project Management	An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.	1. Engineering economics

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 acknowledgment;
- Submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own;
- Failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks; and
- Unless explicitly permitted by the instructor in a specific course, the use of generative AI and similar tools to produce assessed content (such as text, code, equations, images, summaries, videos, etc.).

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For accommodation regarding a formally-scheduled final exam, you must complete the Pregnancy Accommodation Form (click here).

Religious obligation: Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details click here.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send us your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, contact us, if needed, to ensure that accommodation arrangements are made.

You should request your academic accommodations in the Ventus Student Portal, for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm.

Please consult the PMC website for the deadline to request accommodations for formally-scheduled exams (if applicable).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/equity/sexual-assault-support-services

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation will be provided to students who compete or perform at the national or international level. Contact us with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist: https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

In Engineering, the following rules apply to examinations and should be adhered to in the section "Evaluation and Grading Scheme"

a) Final Exam:

i) **Final exams are for evaluation purpose and will not be returned to students.**

ii) Exam is closed-book, non-programmable calculator.

iii) Deferred Final Examinations:

Students who are unable to write the final examination because of a serious illness/emergency or other circumstances beyond their control may apply for accommodation by contact the Registrar's office. Consult the Section 4.3 of the University Calendar (https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/examinations/)

c) Additional requirement(s):

Please consult Section 5 of the undergraduate regulations (https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/grading/)