

Course Outline

ECOR 1032: Circuits and Mechatronics

Fall 2026

1 INSTRUCTOR INFORMATION AND OFFICE HOURS

1.1 INSTRUCTORS

Michael Feuerherm

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1.2 TEACHING ASSISTANTS

See course Brightspace page.

2 COURSE DESCRIPTION AND REQUIREMENTS

2.1 CALENDAR DESCRIPTION:

Electrical circuit fundamentals: resistance, capacitance, inductance, voltage and current sources, Ohm's law, nodal analysis, mesh analysis, source transformation, superposition. Components for mechatronics: filters, operational amplifiers, digital logic gates and combinatorial circuits, analog to digital converters, sensors, actuators, simple control schemes. Project in microcontroller-embedded mechatronic systems.

Includes: Experiential Learning Activity

2.2 PRECLUDED COURSES

Precludes additional credit for ECOR 1043 (no longer offered), ECOR 1044 (no longer offered), and ECOR 1052 (no longer offered).

2.3 PREREQUISITES (AND RECOMMENDED KNOWLEDGE)

This course may not be taken concurrently with ESLA 1300 or ESLA 1500.

Students who have not satisfied the prerequisites for this course must either withdraw from the course or obtain a prerequisite waiver by visiting the Engineering Undergraduate Academic Support Office.

2.4 LEARNING OUTCOMES

By the end of this course students will learn to:

- Analyze electrical circuits using techniques such as loop and nodal analysis, Norton and Thevenin analysis and superposition.
- Apply basic circuit analysis concepts for simple circuits with capacitors and inductors.
- Analyze and design low-pass, high-pass and band-pass filters.
- Operate electrical circuit simulation software.
- Operate electrical laboratory hardware such as function generators and oscilloscopes.
- Implement various sensors and actuators
- Integrate these actuators and sensors into a simple system.
- Analyze analog to digital signal conversion.
- Analyze various types of control systems.
- Demonstrate group work skills

2.5 GRADUATE ATTRIBUTES

The Canadian Engineering Accreditation Board requires graduates of undergraduate engineering programs to possess 12 attributes. 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 our 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.

This following list provides the GAs that will be measured in this course, along with the learning outcomes that are intended to develop abilities related to these attributes.

Graduate Attribute and Level	Indicators or Area for Specialization
GA-1 Knowledge base for Engineering	1.3 - Fundamental engineering concepts

GA-2 Problem Analysis	2.1 - Problem definition 2.2 - Approach to the problem 2.3 - Use of assumptions 2.4 - Interpreting the solution - validity of results
GA-5: Use of Engineering Tools	5.3 - Tools for design, experimentation, simulation, visualization, analysis 5.5 - Limitations of tools and assumptions inherent in their use
GA-6: Individual and Team Work	6.1 - Personal and group time management 6.2 - Group culture and dynamics 6.3 - Leadership: initiative and mentoring, areas of expertise, interdisciplinary teams
GA-11 Economics and Project Management	11.5 - Project definition and management techniques

2.6 TEXTS

Lecture Notes: Lectures notes will be provided which will be sufficient for this course. Students are not required to purchase textbooks or other learning materials for this course.

2.7 COURSE SCHEDULE

This schedule is approximate. Topics may be reordered or adjusted in response to instructional needs or unforeseen circumstances while maintaining the stated learning outcomes and assessment requirements.

Week	Topics
1	Introduction and basic concepts
2	Ohm's law, KVL, KCL, single loop circuits
3	Single and multi-node circuits

Week	Topics
4	Multi-loop and Thevenin's theorem
5	Source transformation, superposition, complex numbers
6	Time varying signals, AC circuits, filters.
7	Bandpass filters
8	Introduction to mechatronics, Operational Amplifiers
9	Time Domain Response, Intro to control theory
10	PID Controllers, Intro to ADC
11	Digital Logic, Sensors
12	Signals and actuators
13	Catch-up and review

2.8 EVALUATION AND MARKING SCHEME

2.8.1 Laboratory

All Labs will be "In-person". Each lab will require a pre-lab and in-lab report submission. Labs will follow the schedule posted on the course page.

2.8.2 Pre-Labs

Pre-labs for all lab sections will be due on Sunday evening each week starting the Sunday prior to labs beginning. Pre-labs will be submitted on Brightspace in the form of an online quiz. Preparing for the pre-lab will enable you to complete experiments efficiently.

2.8.3 Labs

- Lab attendance is a mandatory requirement of the course. A TA will take attendance at each lab session.
- Labs will be performed in groups of 2 students. Submission details are described in the Lab Rules and Instructions document.
- There are 7 labs, and a project for the course as follows:
 - Lab 0: Lab Introduction – this is an ungraded lab and will familiarize students with the lab environment and general use. There is no pre-lab or deliverable associated with this lab
 - Lab 1: Mastering Lab Instruments and Circuit Fundamental

- Lab 2: DC Circuit Analysis and Network Simplification
- Lab 3: Exploring Time-Varying Signals and Transient Response
- Lab 4: Precision Control with PWM and Actuator
- Lab 5: Sensing, Feedback, and Integrated Mechatronic System
- Lab 6: Closed-Loop Control Systems: From Bang-Bang to PI
- Mechatronics Project
- Labs are 3 hours in duration and will be held in Room CB4301. You must attend your lab in the section you are registered. Changing sections is not allowed.
- Lab attendance is a mandatory requirement of the course (to be eligible for a grade for that lab), which will be ensured during lab "Check-out" by a Teaching Assistant. A grade of 'O' in lab Check-out is given to students who did not complete the checkout, whether due to a lack of work or an absence, this means you will get 'O' in your lab report irrespective of your lab report grade. Checkout requires the student to demonstrate the required experimental results and/or answer designated verification questions to the TA before leaving the lab.
- If you are repeating the course, you must redo all the labs. This means doing all the pre-labs, attending all the lab sessions, and submitting all the reports. You may not resubmit any work that you have submitted in previous classes as it is considered a form of plagiarism.
- If a lab is missed for a valid reason, submit proof via the Academic Consideration for Coursework Form (<https://carleton.ca/registrar/academic-consideration-coursework-form/>) within three days — do not email accommodation details. Accommodations are accepted by default unless the instructor contacts you for clarification or to inform you the request has been denied. Approved accommodations may include one makeup lab per term; further accommodated labs receive adjusted grading. Max three (3) labs accommodated per term, consistent with the attendance minimum below.
- Students must physically attend at least three (3) of the six (6) graded lab sessions to pass the laboratory component. This minimum applies regardless of reason for absence, including approved accommodations, and failure to meet it results in a failing grade for the course.

2.8.4 Lab Reports

- Lab reports will be required to ensure students have performed and understood the experiment and recorded and analysed results.
- A lab report must be completed during the lab and submitted before the end of the lab session. Submission details are described in the Lab Rules and Instructions document.
- The Lab Reports grade is calculated as the average of the best 5 of 6 labs. Labs excused under an approved accommodation are excluded from the calculation, with the average taken over the remaining labs and no additional drop applied. Unexcused absences receive a 0, which is included in the average.

2.8.5 Final Group Project

- All students are required to complete a high-level design and analysis exercise. You will complete the project in a mixed-discipline group to act as design team submitting a proposal to management.
- Students are expected to form their own groups. We recommend grouping with your current laboratory table mates. The standard group size is 4 students.
- Students are expected to contribute equitably to group work. Concerns regarding a group member's non-participation should be brought to the instructor as soon as they arise and before the project deadline.
- Lecture Sections: Group members must be registered in the same Lecture Section (A, B, or C). However, members may belong to different Lab sections. TA Assignment: If you are unable to find a group, you will be assigned one.
- More information about the project and the requirements will be located on the Brightspace page.

2.8.6 Midterm Exam

- The midterm exam will be held in-person **on November 7th, 2026 from 11:00AM-12:30PM**. As this falls outside regularly scheduled class time, students who anticipate a conflict with this date should refer to the provisions below regarding missed midterm exams
- The midterm exam will be Closed-Book and Closed-Notes, and no reference materials are allowed. A formula sheet will be provided with the exam paper.
- No electronic device except for a non-graphing and non-programmable calculator is permitted in the midterm exam.
- Students who miss the midterm exam due to an approved academic consideration (see "Academic Accommodations" and "Deferred Term Work" sections of this outline) will have the grade weight of the midterm exam added to the final exam. Students must report a missed midterm and request accommodation in accordance with the deferred term work process described in this outline. Students who miss the midterm without an approved academic consideration will receive a grade of 0 for that component.

2.8.7 Final Exam

- The final exam will evaluate student understanding of all course concepts. As soon as the date of the final exam is confirmed by Scheduling and Examination Services (SES) it will be communicated to you by SES, and you can find it on "<https://carleton.ca/ses/exam-schedule>".
- The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your final examination after the final grades have been made available. This should be done no later than 3 days after the marks are posted.

- The final exam will be Closed-Book and Closed-Notes, and no reference materials are allowed. A formula sheet will be provided with the exam paper.
- No electronic device except for a non-graphing and non-programmable calculator is permitted in the final exam.
- The final exam will be proctored and administered on campus during the final exam period. The exam will be paper-based, and answers will need to be written/indicated on the paper or Scantron sheets.

2.8.8 Grade Calculation

The overall course grade will be calculated as follows:

Component	Weight (%)
Pre-Labs	10
Lab Reports	20
Project	5
Midterm Exam	15
Final Exam	50

- Students who fail the final exam (Achieve a grade of less than 50% on the final exam) will receive a course grade of F, regardless of their marks in the other components. For students who pass the final exam, a numeric mark out of 100 will be calculated by weighting the course components as shown above.
- To pass the course, students must achieve satisfactory performance during the term, defined as a term grade of $\geq 40\%$, calculated as $(\text{Pre-Labs} + \text{Lab Reports} + \text{Project} + \text{Midterm Exam}) \div 50$.

- Final grades are not rounded; the table below describes the numerical grade ranges for each letter grade (Received final grade represented by X):

Letter Grade	Numerical Grade Range
F	$X < 50$
D-	$50 \leq X < 53$
D	$53 \leq X < 57$
D+	$57 \leq X < 60$
C-	$60 \leq X < 63$
C	$63 \leq X < 67$
C+	$67 \leq X < 70$
B-	$70 \leq X < 73$
B	$73 \leq X < 77$
B+	$77 \leq X < 80$
A-	$80 \leq X < 85$
A	$85 \leq X < 90$
A+	$90 \leq X$

2.8.9 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/>)

2.8.10 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 making alternate arrangements with the instructor and 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.

3 COPYRIGHT

The materials (including the course outline and any slides, posted notes, videos, labs, project, assignments, quizzes, exams and solutions) created for this course and posted on this web site are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).

4 ADVISING AND COUNSELLING SERVICES

4.1 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 : <https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/>

4.2 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. Carleton's Wellness Services Navigator <https://wellness.carleton.ca/navigator/> is designed to help students connect with mental health and wellness resources. If you need to talk to someone, please reach out for assistance: <https://carleton.ca/health/emergencies-and-crisis/>.

5 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 at equity@carleton.ca

We will 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.

6 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 quotations marks.

6.1 AI USE POLICY: LEARNING AID ONLY – NO AI CONTENT IN SUBMISSIONS

Generative AI tools are permitted only for the purposes explicitly identified in this AI Use Policy in this document, any use outside of this is prohibited

6.1.1 AI use in this course

Students may use AI tools for ideas, clarifying challenging concepts or getting started on projects. Some acceptable uses include:

- Sounding board (e.g. generating essay topics with ChatGPT, using Microsoft Word’s Smart Lookup or Copilot to find inspiration and related topics)
- Creating outlines (e.g. using AI to structure an essay or presentation flow, using Microsoft Word’s Outline View with AI suggestions)
- Providing definitions or explanations of complex concepts (e.g. using AI to explain a difficult theory or to find relevant information)
- AI-generated explanations may be used to support learning but must not be incorporated into submitted work, whether verbatim or paraphrased.

6.1.2 Documenting use of AI

It is necessary to document your use of AI in this course, using the following guidelines:

- Review, edit and ensure accuracy and originality of final submissions
- AI-generated content should not be present in any final submission deliverables within the course.

- Provide a statement with the deliverable clearly stating whether AI was used, and if so for what purposes.
- Submissions suspected of being AI-generated or heavily AI-assisted may be subject to an in-person verbal verification with the instructor or TA; inability to explain or justify submitted work will be treated as a suspected academic integrity violation.

6.1.3 Why have I adopted this policy?

This policy supports the use of AI as a supplementary tool, helping students develop ideas and structure their work while emphasizing the importance of transparency and personal engagement with the content. AI can be used for inspiration and foundational support and can encourage students to critically assess and refine AI-generated material.

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

Note: Students can also access resources related to citing Generative AI on the [MacOdrum Library website](#). Additional resources are also available on Carleton's [Artificial Intelligence Hub](#).

7 ACADEMIC ACCOMMODATIONS

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

7.1 PREGNANCY OBLIGATION:

Write to me 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.

7.2 RELIGIOUS OBLIGATION

Write to me 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.

7.3 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 me 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, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

7.4 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>

7.5 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. Write to me 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.