Carleton University Department of Electronics

Fall 2025

ELEC3105: Basic EM and Power Engineering

Introduction

In this course you will learn basic electromagnetic theory, culminating in the derivation of the time dependent maxwell's equations.

Course Description and Requirements

Course Description: Electrostatics and magnetostatics. Solution of Poisson's and Laplace's equations. The Lorenz equation and force. Time varying fields. Magnetic circuits and transformers. DC and AC motors
Prerequisite(s): MATH 2004 and (PHYS 1004 or PHYS 1002).
Lectures: 3 hours per week.
Laboratory and problem analysis: 3 hours alternating weeks.

Instructor

Professor: Christopher W. Smelser
Email: Christopher.Smelser@carleton.ca
Course Webpage: on Brightspace

Textbook: Please include price of books

1) Elements of Electromagnetics, Matthew N. O. Sadiku ISBN 978-0-19-932138-4

Lecture Outline

In person, Date & Time
The following topics will be covered during the course lectures with an approximate schedule:
Week 1: Introduction, review of vector algebra and calculus
Week 2: Review of vector Calculus cont'd
Week 3: Electrostatic fields
Week 4: Electrostatic fields in material space
Week 5: Material space cont'd, Electrostatic Boundary Value Problems
Week 6: Solution of Laplace and Poisson's equation, Numerical Methods
Week 7: Conductors, Resistance, Capacitance, Boundary Conditions
Week 8: Magnetic Fields, Biot-Savarts Law, Ampere's Law, Magnetic Dipoles
Week 9: Magnetic Vector Potential, Boundary Conditions
Week 10: Inductance, Magnetic Circuits
Week 11: Farady's Law, Displacement Current, Maxwell's equations in final form

Week 12: Electromagnetic Waves, Guided Waves, Review

Laboratory and Problem Analysis Sessions

3 hours (alternate weeks) as per schedule and location posted on Brightspace.

Notes for Labs

- There are 4 labs as follows:
  - Lab 1: Intro to ANSYS
  - Lab 2: Numerical Solution of Laplace's equation
  - Lab 3: Numerical Solution of Magnetostatic Problems
  - Lab 4: Cable Impedance
  - Lab 5: Near Field Inductance Communication

- Labs are 3 hours in duration and will be held in Room ME 4275. Labs and PA sessions usually "alternate" from week to week and will be held according to the schedule shown on the course module in Brightspace. You must attend your lab in the session you are registered. Changing sessions is not allowed without the instructor's permission. 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. Some labs have a pre-lab exercise that must be completed before the start of your lab period. You are not permitted to do the lab unless the prelab is completed. The TA will check that the the pre-lab has been completed.
- A lab report will be submitted online for each lab and by each student. A template for each lab report will be provided. Lab reports are due by midnight on the day of the lab. Late lab reports must still be submitted. One day late it will only be worth 50%. Two days late, it is worth 0.

Notes for PA Sessions

- Several problems will be assigned each week as homework to help understand the lecture material, prepare for the midterm exams and final exam. To learn the course material, **IT IS ESSENTIAL THAT YOU ATTEMPT SOLUTIONS FOR THESE PROBLEMS BEFORE THE PA SESSION**. Solutions to these problems will be reviewed in the PA sessions.
- Due to a shortage of TAs this term, PA sessions will comprise videos of previous online PA sessions so students can view them any time during the week that the problems are assigned. The course instructor will arrange a Zoom meeting in the week following the PA session to answer questions about the problems assigned the previous week and their solution or important concepts addressed in the problems, but not to repeat a complete solution already contained in the video.

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:
20% of the final grade : 4 labs
40% of the final grade : Three tests (best 2 of 3)
40% of the final grade : Final Exam, TBD. Timed exam: 3 hours.

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

i) Final exam is closed book and a grade of 50 % is required on the final exam to pass the course. You are allowed a non-programmable calculator and an equation sheet will be provided for the exam.

ii) 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/)

b) Additional requirement(s):

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

If additional requirements beyond the cumulative grade earned in the course (for example, a requirement that students complete/pass certain assignments, examinations, lab, project components, or attend a minimal number of lab/PA sessions in order to pass the course), this should be clearly identified in the course outline.

c) Exam format and e-proctoring statement

Engineering Courses shall have on campus and proctored final examinations. The final exam may be in electronic format (ie. Student will write the exam on campus and use either their computer or a university-owned computer).

Learning Outcomes

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

1. Introduce the students to Electro and Magnetostatics.
2. Reinforce concepts through Matlab examples.
3. Introduce Maxwell's equations, discuss wave propagation and solve equation for simple slab waveguide.

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. Knowledge base for Engineering	Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	Tests, Exam
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.	Tests, Exam

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