Carleton University Department of Electronics

Outline
ELEC 3105 Electromagnetic Fields
Winter 2026

Instructor
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Textbook: M. Sadiku, "Elements of Electromagnetics", 7th edition, ISBN 978-0-19-932138-4
Additionally, course notes will be provided online through Brightspace.

Prerequisites: The course precludes additional credit for ELEC 2601 or ELEC 3504. Pre-requisites are MATH 2004 and (PHYS 1004 or PHYS 1002).

Course Outline:

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

- Vector calculus: gradient, divergence, curl, coordinate systems
- Basic Electrostatics: Coulomb's force law, electric field, electric field lines and flux, Gauss' law and divergence, electrostatic potential, Poisson's equation and Laplace's equation, gradient of electric field, method of images; numerical solution of Laplace's equation
- Electric Fields in Matter: polarization and dielectrics, the displacement field, the pn junction depletion region, the solar cell, electrostatic problems with dielectrics, current flow: resistivity and conductivity
- Magnetostatics: Lorentz force law, Hall effect, Ampere's law, curl of a vector field, the magnetic vector potential, the Biôt-Savart Law, applications of the Biôt-Savart Law: current ring, solenoid, energy stored in magnetostatic field
- Magnetic Fields in Matter: magnetic dipoles, types of magnetic materials, hysteresis, magnetic circuits
- Faraday's Law and Time-Varying Fields: Faraday's law and induced EMF, Lenz's law, eddy currents, displacement current, Maxwell's Equations

Evaluation Scheme:

4 Labs + Lab 0	20%
3 Assignments	10%
Learning Objective Project	10%
Midterms (Best 2 of 3)	20%
Final Exam	40%

A grade of at least 50% on the final exam is required to be eligible to pass the course. Students must complete all labs to be eligible to pass otherwise a grade of F can be assigned.

Laboratories:

Lab sessions are 3 hours in duration. Individual Labs will be held according to the schedule which is posted on Brightspace. You must attend the Lab which you are registered in.

You must complete all Labs and Assignments. Lab 0 will be an intro to ANSYS and Labs 1 and 2 will require you to use of the ANSYS program to obtain simulation based results. Retain records of your graded lab reports and Assignments until the end of term in case they are needed to confirm your grades.

The intention is to have the labs in-person at Carleton University. The room for the labs will be ME4275 (**Not the PA room listed on Brightspace**). There will be 4+1 labs scheduled over the term. Each student is required to independently complete and submit all laboratory reports. Submitted reports will be held to the same standard as the in person labs on Carleton campus and should be high quality documents. Lab reports should convey all data, calculations, graphs etc. and contain the necessary conclusions and discussions. All submitted reports must be in PDF file format. Students have the choice of software and materials to prepare their reports but reports must be neat, legible and coherent. Discretionary deductions may be applied to illegible and sloppy reports.

The first 2 labs are simulation based and you will be given approximately 2 weeks to complete each lab before submission on a scheduled due date. The TAs will be available in the lab and during the scheduled lab period. If you require assistance, go to your scheduled lab period and location.

For Lab 3 and Lab 4, you must attend your scheduled lab section as this will determine when you can access the lab computers. Labs 3 and 4 are to be submitted within 24 hours from the end of the lab period. In the event of a documented absence, you may attend an alternate lab section with instructor or TA consent. Lab exemptions are not granted under any circumstances for accreditation purposes.

Carefully read the pre-lab requirements well in advance of your scheduled lab period. Some labs require that the pre-lab be completed prior to the lab. If pre-lab completion is required prior to your lab commencement, TAs will examine that the pre-lab is completed at the start of the lab. Should you not have your prelab completed, or with you, you will be asked to leave the lab and return when you have completed the prelab. There is a penalty of 50% per day for late lab reports.

Assignments:

You are expected to solve and understand all the problems in the Assignments. You are allowed and encouraged to work with other classmates on the problem sets, this is for the benefit of understanding the material. You will be required to submit your assignment on the due date listed on Brightspace. In your assignment submission I ask that you credit your collaborators if there are any. There is a penalty of 50% per day for late Assignments.

Learning Objective Project:

Every student will be required to complete a learning objective project. Students will need to choose a learning objective from a list and design a 3-4 slides that could teach an objective to the class. The breakdown of this project is 5% of your final grade will be awarded based on participation only. The remaining 5% will be awarded based on your ability to convey the learning objective. You will be required to a video of your presentation to be graded on your communication ability. This will allow you to redo your presentation if necessary. The presentations will be due the final week of class.

Course materials, such as textbooks, notes, etc. are permitted during labs. Please note: it is strongly recommended you review this material BEFORE coming to the lab. Please come prepared!

Midterms:

There will be 3 midterms during the term. They will be held during class time at the following tentative dates:

Midterm 1 ..... Thursday, February 12th
Midterm 2 ..... Tuesday, March 17th
Midterm 3 ..... Thursday, April 2nd

The best of 2 of 3 midterms will be considered to account for 20% of your final grade. Please make sure you attend the midterm during the scheduled time. Midterms will be **Closed Book** but a 1 page sheet of formulas and notes will be permitted.

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 exam will take place during the December examination period.
- 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 format of the final exam is **Closed Book** but a 1 page sheet of formulas and notes will be permitted. You will be permitted a non-programmable university exam approved calculator. Full exam conditions will be in effect.
- No electronic device except for a non-graphing and non-programmable calculator is permitted in the final exam.

Exam format and proctoring statement 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.

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 contacting the Registrar's office. Consult the Section 4.3 of the University Calendar (https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/examinations/)

Graduate Attributes

The Canadian Engineering Accreditation Board requires graduates of undergraduate engineering programs to possess 12 Graduate Attributes (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.

1. **A knowledge base for engineering**: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

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.

Graduate Attribute and Level	Indicators or Area for Specialization
GA-1 Knowledge base for Engineering	1.11- 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

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/Head TA 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 and in all cases before the last day of classes in the term as published in the academic schedule.

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 quotation marks; and

Generative Artificial Intelligence (AI):

Use of generative AI tools (such as ChatGPT) can serve you as a valuable learning tool. However like any reference, 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 Accommodation

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).

Advising and Counselling services

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/

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/.

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.

General Regulations

Attendance

Students are expected to attend all lectures and lab periods in-person. Lab attendance is a mandatory requirement of the course. The University requires students to have a conflict-free timetable. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 1.2, Course Selection and Registration and Section 1.5, Deregistration.

Health and Safety

Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: http://sce.carleton.ca/courses/health-and-safety.pdf

Appeal of Grades

The processes for dealing with questions or concerns regarding grades assigned during the term and final grades is described in the Undergraduate Calendar, Academic Regulations of the University, Section 2.7, Informal Appeal of Grade and Section 2.8, Formal Appeal of Grade.

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