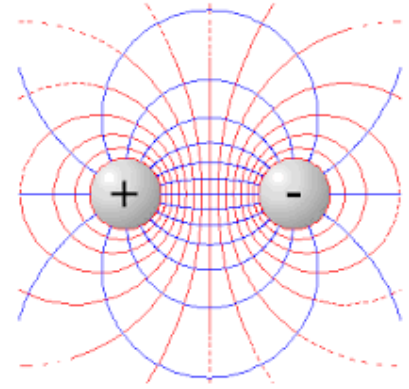


**Carleton University**  
**Department of Electronics**  
**ELEC 3105 Electromagnetic Fields**  
**Course Outline**  
**Fall 2023**



**Instructor:** Dr. Mohamad Alzayed  
**Office:** 3303 Canal Building  
**E-mail:** [MohamadAlzayed@cunet.carleton.ca](mailto:MohamadAlzayed@cunet.carleton.ca)  
**Office Hours:** By appointment Online or In-person  
**TAs:** TBA

**Course Objectives:**

This course introduces the fundamental of Electromagnetic Fields and their applications. It mandates grasping the fundamentals initially, followed by the process of logical application of those basics to tackle problems in electromagnetism.

**Course Description:**

Vector calculus: gradient, divergence, curl, integration of vector fields. Electrostatics, magnetostatics. Boundary conditions. Poisson's and Laplace's equations: method of images, separation of variables, iterative method. Electric and magnetic properties of matter. Magnetic circuits. Lorentz force. Motional emf, electromagnetic induction. Maxwell's equations.

**Prerequisites:** MATH 1005, MATH 2004 and (PHYS 1004 or PHYS 1002).

**Textbooks:**

- M. Sadiku, "Elements of Electromagnetics," 7th edition. ISBN-13-978-0190698614
- Additional course notes will be provided online through Brightspace.

**Evaluation Procedures:**

- 4 Labs + Lab 0 . . . . . 20%
- PA Quiz (Best 4 of 5) . . . . . 20%
- Midterm. . . . . 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** will be assigned.

## Lab and PA Schedule:

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

You must complete all Labs. There will also be a mandatory Lab 0 that is designed to familiarize yourself with ANSYS Software (Labs 1 and 2). Retain records of your graded lab reports and quizzes until the end of the term in case they are needed to confirm your grades. The PA room listed on Carleton Central will be used to go over assignment/Quiz questions with the TAs during the term.

## Laboratories:

The intention is to have the labs in-person at Carleton University. The lab room location will be posted on Brightspace. There will be 4 labs scheduled over the term. Each student is required to independently complete and submit all laboratory reports. Submitted reports 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. A PDF of a handwritten lab report is not acceptable. 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 Lab 3 and Lab 4 are hardware-based. You must attend your scheduled lab section. Lab reports 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 the instructor or TA consent. Lab exemptions are not granted under any circumstances for accreditation purposes.

The TAs will be available in the lab and during the scheduled lab period. If you require assistance, go to the scheduled lab period and location.

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 **20%** per day for late lab reports.

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

## Assignments, Quizzes, and PA Sessions:

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. **A sampling of the assigned questions will be taken up by the TA in the PA session.** Your answers to the assigned questions are for your records only and are not submitted on Brightspace. You must attend your scheduled PA section and take the quiz in your PA session. If you miss a PA session, it is

up to you to obtain answers to the assigned questions. Also, if you miss the PA session quiz, there is no makeup quiz as your quiz grade is computed from the best 4 out of 5 quiz grades (missed quiz is graded 0). Measures are in place should we be required to perform PA sessions remotely. **NOTE: The PA session quiz may be delivered online through a quiz on Brightspace. Ensure that you bring with you to the PA session an electronic device that permits you access to the online quiz.**

Course materials, such as textbooks, notes, etc., are permitted during PA sessions and Quizzes as well. Please note that you strongly recommend reviewing this material BEFORE coming to the PA session. Please come prepared!

### **Mid-term:**

There will be 1 mid-term during the term. **The mid-term will be held during the regular class time.** The mid-term will account for 20% of your final grade. Please make sure you attend the mid-term during the scheduled time. Mid-term will be a **Closed Book**. If you miss the mid-term with a valid reason, a makeup mid-term will be made available. Sorry, no makeup of a makeup mid-term. A grade of zero is assigned to a student who misses the makeup mid-term. Under no circumstances will the grade weight of the mid-term be transferred to the final exam.

### **Final Exam:**

The final exam will be in-person and scheduled through examination services. The format of the final exam is a **Closed Book**. You are not allowed to bring an equation page. You will be permitted a non-programmable university exam-approved calculator. Full exam conditions will be in effect. There will be no collaborations of any sort permitted on the exam, and this will be flagged as plagiarism subject to university regulations.

### **Lecture Topics:**

The list below indicates possible topics and tentative schedules covered in the course.

- Week 1 - Introduction to Electromagnetic Fields.
- Week 2 - Vector Analysis and Calculus.
- Week 3 - Electric Field, Coulomb.
- Week 4 - Electric Flux, Gauss.
- Week 5 - Poisson's and Laplace's Equations
- Week 6 - Poisson and Laplace Numerical Solutions
- Week 7 - Virtual Work/ Electric and Energy Potential.
- **Week 8 - Fall break, no classes.**
- Week 9 - Electric Dipole and Corona Discharge.
- Week 10- Magnetostatics: Magnetic Field, Hysteresis, Lorentz Force, and Hall Effect.
- Week 11- Ampere Law and Biot-Savart Law.
- Week 12- Distribution system reliability
- Week 13- Magnetic Flux, Induced, Faraday's Law, Lenz's Law, and Motional emf.
- Week 14- Electromagnetic Field Applications: Transformer, Motors, and Generators.

## **Graduate Attributes:**

The Canadian Engineering Accreditation Board (CEAB) has established that an institution must demonstrate that graduates of its programs possess certain defined attributes. The institution must also implement and employ processes to demonstrate that program outcomes are being assessed in the context of these attributes and that the results of such assessments will be applied to the further development of programs. The graduate attributes relevant to this course are:

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.

This course (ELEC 3105) will score attributes 1 (Knowledge Base) and 2 (Problem Analysis). They are scored through the responses provided in the mid-term, final exam and/or lab reports. The graduate attribute scores will be derived from graded material.

**Plagiarism Policy:** When you use (for example, quote or even summarize or paraphrase) someone else's media, words, data, ideas, or other works, you must cite your source. You should be especially careful to avoid plagiarizing Internet sources (for example, e-mail, chat rooms, Web sites, or discussion groups). It does not matter whether you borrow material from print sources, the Internet, online databases, or interviews. Failure to cite your source is plagiarism. Students who plagiarize may receive an "F" or a "0" for the assignment or an "F" for the course. Plagiarism is a serious instructional offense that can not be tolerated. For additional information, please refer to the section on instructional offenses in the Undergraduate Calendar.

**Use of Course Materials:** Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy-protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s). Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

**Attendance Policy:** When you miss a class, it is your responsibility to obtain the missed information.

**Student E-mail Policy:** The University sends official communications to Carleton e-mail addresses. This address will receive notices about schedules, grade results, billing information, emergency alerts, important deadlines, newsletters, and all other official university information. It is your responsibility to read and manage this e-mail. Make sure you receive any correspondence in regard to this course. Please note the instructor of this course is not responsible for missed e-mail communication directed to your spam folder.

**Examination Policy:** The use of communication or recording/playback devices, with the exception of devices explicitly permitted by the course instructor, is prohibited during quizzes and examinations. This includes, but is not limited to, cell phones, PDAs, iPods and MP3 players, tablets, computers, cameras, and headphones or in-ear earphones. All such devices must be turned off and put away in an inaccessible location, such as a backpack. Accessing a prohibited device will result in the immediate termination of the quiz or examination and may result in a charge of academic misconduct.

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

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 more details, visit the Equity Services website: [http://carleton.ca/equity/accommodation/student\\_guide.htm](http://carleton.ca/equity/accommodation/student_guide.htm)

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. For more details, visit the Equity Services website: [http://carleton.ca/equity/accommodation/student\\_guide.htm](http://carleton.ca/equity/accommodation/student_guide.htm)

Students with disabilities requiring academic accommodations: In this course, you must register with the Paul Menton Centre for Students with Disabilities (PMC) to formally evaluate disability-related needs. Documented disabilities could include but are not limited to mobility/physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC at 613-520-6608, every term to ensure that I receive your Letter of Accommodation no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you only require accommodations for your formally scheduled exam(s) in this course, please submit your request for accommodations to PMC by the last official day to withdraw from classes in each term. For more details, visit: [http://www.carleton.ca/pmc/students/acad\\_accom.html](http://www.carleton.ca/pmc/students/acad_accom.html)