ELEC 3105 Electromagnetic Fields
Winter 2024 - Syllabus[1]

Department of Electronics
Carleton University

Teaching team:

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- TAs[2]: Noah Guy, Amir Akbari, and Kam Kedze

Course Outline:

- 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, displacement field, pn junction depletion region, solar cell, electrostatic problems with dielectrics, resistivity and conductivity;
- Basic magnetostatics: Lorentz force law, Hall effect, Ampere's law, curl of a vector field, magnetic vector potential, Biot-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.

Prerequisites:

- MATH 2004 and PHYS 1004 or PHYS 1002

Textbook and other learning material:

- Required textbook: M. Sadiku, "Elements of Electromagnetics", 6th or 7th edition, ISBN 978-0-19-932138-4
- Course notes: provided online through Brightspace prior to the lectures.
- Slides presented during the lectures: provided online through Brightspace after the lectures.
- Documentation for lab preparation: provided online through Brightspace prior to the laboratories.

Evaluation scheme:

- 4 laboratories (+ introductory lab): 20%
- 3 assignments 20%
- 2 midterms (best one worth 15%, the other 10%) 25%
- Final Exam 35%

- A grade of at least 50% on the final exam is required to be eligible to pass the course. Students must complete all laboratories to be eligible to pass.

[1] This syllabus and overall course material are based to a large extent on those developed by the previous instructors, in particular Prof. C. Kupchak and Prof. B. Syrett.
[2] Subject to change.

Schedule (everything is in-person):

- Lectures:
  - Monday and Wednesday, 2:35 pm - 3:55 pm, LA A720 (as specified in Carleton Central).
- Laboratories:
  - The 5 labs will be held according to the location & schedule soon to be posted on Brightspace.
  - 3 hours in duration; day of the week and time of the day specified in Carleton Central.
  - You must attend the Lab session you are registered in.
- PA sessions:
  - Several PA sessions will be held during the winter; schedule soon to be posted on Brightspace.
  - 3 hours in duration; day of the week, time of the day, and location specified in Carleton Central.
  - You must attend the PA session you are registered in.
- Midterms:
  - Held during lecture time; dates soon to be posted on Brightspace.
- Final exam:
  - Scheduled through examination services.

Laboratories:

- Description of the 4 (+1) laboratories:
  - Lab 0: Introduction to familiarize yourself with the ANSYS software (used in Labs 1 and 2).
  - Lab 1: Simulation: Numerical Solution to Laplace's Equation
  - Lab 2: Simulation: Numerical Solution of Magnetostatic Problems
  - Lab 3: Experimental: Cable impedance
  - Lab 4: Experimental: Near-field induction communication
- Preparation:
  - Carefully read the lab documentation pre-lab requirements in advance of your lab session.
  - 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.
- During the labs:
  - The TAs will be available in the lab if you require assistance.
- Lab reports:
  - Each student is required to independently complete and submit all laboratory reports.
  - Each lab report is due 48 hours from the end of your lab session (there is a penalty of 20% per day for late lab reports).
  - The reports should be high-quality documents (neat, legible, and coherent) submitted in PDF file format. The students have the choice of software to prepare the reports.
  - The reports should convey all data, calculations, graphs, conclusions, and discussions.
  - The reports will be graded based both on the content and on the presentation quality.
  - Please retain records of your graded lab reports until the end of term in case they are needed to confirm your grades.
- In the event of a documented absence, you may attend an alternate lab section with instructor or TA consent. Lab exemptions are not granted.

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. Please credit your collaborators if there are any.

- You will be required to submit your assignment on the due dates soon to be listed on Brightspace (there is a penalty of 20% per day for late assignments).
- Please retain records of your graded assignments until the end of term in case they are needed to confirm your grades.

Midterms and final exam:

- Closed book but a 1-page sheet (both sides) of formulas and notes will be permitted.
- Non-programmable university exam approved calculator will be permitted.
- 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

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 will score attributes 1 (Knowledge Base) and 2 (Problem Analysis). They are scored through the responses provided in lab reports, assignments, and exams. The graduate attribute scores will be derived from graded material, however they are for internal use only.

Policies:

- Plagiarism: Plagiarism is a serious instructional offense that will not be tolerated. Copying someone else's work, or even your own, is cheating. Please refer to the section on instructional offenses in the Undergraduate Calendar for additional information.
- Use of course materials: Classroom teaching and learning activities, including lectures, are copy protected and remain the intellectual property of their respective author(s). All course materials, including lecture slides, 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.
- Examination: The use of communication or recording/playback devices, with the exception of devices explicitly permitted by the course instructor, is prohibited during 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 examination and may result in a charge of academic misconduct.

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: Please 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
- Religious obligation: Please 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
- 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