

ELEC 3909 Course Outline Fall 2021: Electromagnetic Waves

Course Contents: Maxwell's equations and EM wave solutions. Polarization. Poynting vector. EM waves in dielectrics and conductors; skin depth. Reflection and refraction. Standing waves. Fresnel relations, Brewster angle. Transmission lines. Line termination, basic impedance matching and transformation. Smith charts. Introduction to guided waves; slab waveguide.

Prerequisite: ELEC 3105 or permission of the Department.

Lectures: Twice a week: [Monday and Wednesday 6h05-7h25pm In-person Lectures with Zoom option](#)

Problem analysis: 3 hours every two weeks (for each section).

Instructor: Shulabh GUPTA, Mackenzie Building, room 4160 (office) shulabh.gupta@carleton.ca

Office hours: Questions by email/Brightspace Forum.

Teaching Assistant:

Keigan MacDonell (KeiganMacdonell@cmail.carleton.ca) and **Jordan Dugan** (JordanDugan@cmail.carleton.ca)

Course Format: The class is offered both in-person and online. While the students may choose to attend the lecture either live or in-person, the attendance in the Problem Analysis Session must be chosen in the beginning of the course. Exceptions can be made for valid reasons, and any change must be approved by your TA.

1. Marking scheme:

1 Final exam (During normal exam period): weight 50% but you need to pass the final exam with at least 50% to pass the course

- The Final exam will be scheduled during examination period at the end of the Summer term. Rules for a missed final exam are covered in Carleton's undergraduate calendar.
- The exact rules of the final exam will be announced during the course. It is expected to be timed open book take home examination.
- The final exam is exclusively for the purpose of evaluating student performance and will not be returned.
- Students who miss the final exam may be granted permission to write a deferred examination. See the Undergraduate Calendar for regulations on deferred examinations.

4 Quizzes (best 4 out of 5): quizzes will count for 30% of the final grade (4 x 7.5%)

- Quizzes will occur during the last hour of each PA session (except the first one) and will be conducted online using the CuLearn Moodle Platform for those who opted to attend the course online. Those who chose an in-person option will write it live in the campus (handwritten). Quizzes will be open-book for all.
- First PA session will be reserved for tutorial on **Ansys High Frequency System Simulator (HFSS), MATLAB, Latex (Overleaf)** and basic recap on the mathematical concepts required in the course.
- Missing a quiz without a valid reason (medical certificate) will result in a mark of zero for that quiz. If you know in advance that you cannot attend a quiz, and can support it with a valid reason, then we can possibly arrange for an accommodation.
- Quizzes are open book format. You are free to bring whatever textbook material you think will help you in answering your questions.
- No discussions between students allowed. Any evidence of discussions, cheating, or something similar, during both the final exams or quizzes, will have serious consequences.
- Students registered in their own PA sessions only will be allowed to attend the quizzes. No switching allowed.

Short Problems: total weight of 20%

- There will be total two (2) problem sets in the entire term, which will be posted on CuLearn at least **2 weeks** before the respective submission deadlines.
- The document must be prepared using **Latex only using the templates provided and submitted as a pdf file, in standard IEEE format**, with suggested section headings and specified page limits. Latex template will be provided in advance. Any submissions not following the IEEE format, will not be accepted.
- The prepared document must be electronically submitted on Brightspace by: **October 31, 2021 (Set 1)** and **December 8, 2021 (Set 2)**. Late submissions are allowed until Dec 12th with not penalty.
- While you are free to discuss the problem with your colleagues, the final submitted document must be prepared by you.
- Assignment documents must be named according to the following format:
Lastname_Firstname_ELEC_3909_Fall_2021_Assignment_#.pdf, where # is 1 or 2, depending on the assignment number.
Proper naming conventions and file formatting will be strictly enforced for proper organization of the material. Any submission not following these rules will not be marked and returned to the student.

- Assignment set 1 will be returned with feedback after markings, however assignment set 2 is exclusively for the purpose of evaluating student performance and will not be returned.
- Assignment #1 must be done in pairs, while Assignment #2 can be done individually.

2. Satisfactory performance to pass the course:

1- Minimum term course grade of 50% AND

2- Minimum grade of 50% in final exam.

Students must review their assignment and quiz grades as soon as they are given back to them. Any marking concerns, and clarifications must first be directly addressed to the TAs. In case, TA's clarifications are not sufficient or students are not satisfied with their markings, they must bring this to my attention as soon as possible. I will treat such instances as a informal appeal and will review/re-mark the quizzes/assignments in question. All such cases, must be brought to me before **December 16, 2020**.

3. Academic Accommodation

You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy or religious obligations. Please review the course outline promptly and write to me with any requests for academic accommodation as soon as possible after the need for accommodation is known to exist. Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but 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, 613-520-6608, every term to ensure that your Instructor receives 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.

4. PA sessions

The first 2 hours of each PA session will be used to answer your questions and do sample problems with the Teaching assistants. In the last hour of the PA there will be a quiz. No quiz on the 1st PA session. The purpose of the PA session is to go over the solutions to some of the suggested problems. Don't expect the TA to solve all the assigned questions. It is expected that each student would have tried and solved most of the questions prior to the commencement of the PA session. **Only the Final answers will be provided for selected problems.**

5. Textbooks and other learning resources

There are no official textbook for this course. However, some suggested textbooks covering the course contents are:

1. M. Sadiku, "Elements of Electromagnetics", 6th edition.
2. Branislav M. Notaros, "Electromagnetics," (Prentice Hall, 2011).
3. David J. Griffith, "Introduction to Electrodynamics", Pearson.

I will be using slides in classes. Additional material will be used to reinforce the understanding. Several good textbooks covers Electromagnetics and studying from them outside lecture hours is strongly recommended: **If you were to attempt to study and pass the final exam by using only the lecture slides, you would likely fail the course.** The lecture slides will be available to you after every lecture, however.

Note: If there are any important changes, they will be communicated to you, well in advance.

6. Professional Engineering Accreditation Requirements

Graduate Attributes: An institution must demonstrate that graduates of its programs possess the attributes described below. In addition, the institution must 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 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.

3. **Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
4. **Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **Individual and team work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **Impact of engineering on society and the environment:** Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **Ethics and equity:** An ability to apply professional ethics, accountability, and equity.
11. **Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. **Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

This course (ELEC 3909) will score attributes 1.6.E - Knowledge base: Discipline-specific concept DOE-3: Electromagnetics, 2.1 - Problem analysis: Problem definition, 2.2 - Problem analysis: Approach to the problem, 2.3 - Problem analysis: Use of assumptions, 2.4 - Problem analysis: Interpreting the solution - validity of results, 4.1 - Design: Clear design goals, 4.2 - Design: Detailed design specifications and requirements, 4.4 - Design: Design solution(s), 4.5 - Design: Design implementation / task(s) definition, 4.6 - Design: Alternate solution(s) definition, 4.7 - Design: Evaluation based on engineering principles. They are scored through the responses provided in assignments, quizzes, pre-lab and lab reports, presentations, final exams. The graduate attribute scores may in some cases be derived from graded material, however the graduate attribute scores are not used in determination of the final grade for the course.

7. OTHER important issue: COPYRIGHT:

“I would like to remind you that my lectures and course materials, including power point presentations, outlines, and similar materials, are protected by copyright. I am the exclusive owner of copyright and intellectual property in the course materials. You may take notes and make copies of course materials for your own educational use. You may not and may not allow others to reproduce or distribute lecture notes and course materials publicly for commercial purposes without my express written consent.”