

ELEC 3909

COURSE OUTLINE Winter 2016

Electromagnetic Waves

Course content:

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: three hours a week: Mondays and Wednesdays 2h35-3h55pm Azrieli Theater 301

Problem analysis: three hours alternate weeks (schedule provided below).

Instructor: Jacques ALBERT

Minto Center, room 7068 (office) or 5041 (lab)

jacques_albert@carleton.ca

OFFICE HOURS: Wednesdays 11am-1pm.

Summary of course organization and schedule:

6 modules cover the complete material for the course, as described in a separate document ("Detailed course schedule") on cuLearn. Each module takes up 2 weeks of lectures. The first five modules will be followed by two weeks of PA sessions (one PA session per section), during which problems will be demonstrated by TAs, and a quiz will be given at the end. The last module will not have a quiz but will have an assignment as well as a drop-in PA session.

Marking scheme:

1 Final exam: **weight 40%** **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 Winter term. Rules for a missed final exam are covered in Carleton's undergraduate calendar.

5 Quizzes: the **best 4 out of 5 will count for 40%** of the final grade

Quizzes will occur during the last hour of each PA session (dates below). Quiz questions will vary from section to section in each module.

- 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 convince the instructor that you have a very good reason to do so, then it may be possible to arrange for an accommodation.
- **OTHERWISE: NO SWITCHING OF PA SECTION. If you attempt to do it without permission you will get a grade of zero for that Quiz.**

6 Assignments (one for each module): total **weight of 20%**

There will be one assignment per module. The assignment questions will be provided on the first day of each module and the assignments due on the dates provided in the "Detailed course schedule" document on cuLearn. There will be a deduction of 25% of the assignment value per day for late assignments (no need to bring them in after the third day...). The purpose of the assignments is mostly to force you to work out some problems on your own, not to evaluate you. Therefore they are relatively easy and allow you to bring up your grades.

Assignments that are not "clean" and professional looking will not be marked and given a grade of 0.

Satisfactory performance to pass the course:

1- Minimum final course grade of 50%

AND

2- Minimum grade of 50% in final exam.

Notes: The final exam is exclusively for the purpose of evaluating student performance and will not be returned.

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 during the first two weeks of class, or 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.

PA sessions: The class is divided into 5 sections of about 30 students and each section has one PA session every two weeks. Problem sets will be assigned every two weeks. 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 based on the current problem set.

During the first week of class Week 1 (ODD), from January 11 to 15 there will be “drop in” PA sessions on Tuesday and Wednesday from 8h35 to 11h25, with a TA present (at least for the first hour) to answer refresher questions about complex numbers and vector analysis. Please take a look at Ulaby, Section 1-6, as well as Ch. 3, to see whether you need TA help.

PAs with quizzes start on January 19 (Week 2 of the course, Even week, section L2E). The last regular PA sessions (with a Quiz for Module 5) will be held in the last two full weeks of the Winter term (between March 29 and April 8 depending on your section). **NOTE: because of the Good Friday holiday, the EVEN week PA sessions for Module 5 from the March 22-25 week are moved to the April 5-8 week.**

Winter Break: February 15-19 (includes February 15 statutory holiday). Classes and PA sessions suspended.

SCHEDULE FOR PA SESSIONS with a QUIZ

Section L1O	Section L2E	Section L3O	Section L4E	Section L5E
Tue: 8h35-11h25 ME 4342	Tue: 8h35-11h25 ME 4342	Wed: 8h35-11h25 SH 501	Fri: 8h35-11h25 ME 4342	Fri: 14h35-17h25 TB 236
Jan 26	Jan 19	Jan 27	Jan 22	Jan 22
Feb 9	Feb 2	Feb 10	Feb 5	Feb 5
Mar 1	Feb 23	Mar 2	Feb 26	Feb 26
Mar 15	Mar 8	Mar 16	Mar 11	Mar 11
Mar 29	Apr 5	Mar 30	Apr 8	Apr 8
<i>DROP-IN PA SESSIONS WITH TA HELP (Not mandatory, only if you need some help)</i>				
<i>Jan 12 and 13, 8h35 to 11h25 (Complex numbers, vector analysis, elementary waves)</i>				
<i>Mar 22, 8h35 to 11h25 (Review of Modules 1 to 4)</i>				

TEXTBOOK and other learning resources

- 1- The textbook for the class will be “Fundamentals of Applied Electromagnetics”, by F. T. Ulaby, E. Michielssen, and U. Ravaioli, 7th edition (Prentice Hall, Upper Saddle River, 2015). We will be using chapters 1, 2, 7, and 8, plus parts of chapters 3 and 6 from the book.
- 2- The 5th and 6th editions are very similar so that would do if you have it already.
- 3- You can buy the book or “rent” it for the term (~90\$, from the bookstore).
- 4- When buying the book you get access to a CD with Matlab programs, some solutions, and get access to some online additional material.
- 5- A few copies of the book will be available on reserve at the Library.
- 6- Most examples and problems will be taken from the textbook, with additional material from other well known textbooks on EM waves.
- 7- Other good textbooks with the same content (more or less) to study from:
 - a. Wentworth, “Applied Electromagnetics: Early Transmission Lines Approach,” (Wiley, 2007).
 - b. Sadiku, “Elements of Electromagnetics”, 4th ed. (2007, Oxford University Press)
 - c. Notaros, “Electromagnetics,” (Prentice Hall, 2011)
 - d. a freely available textbook on the web (slightly more advanced but very good otherwise): Orfanidis, “Electromagnetic Waves and Antennas,” <http://www.ece.rutgers.edu/~orfanidi/ewa/>
 - e. J. Edminister, "Schaum's Outlines Electromagnetics," Second Edition, ISBN 0-07021234-1

I will be using Powerpoint slides in class. All the figures, equations, and worked out exercises will come from Ulaby. Additional material will be used to reinforce understanding but will not represent material on which you will be examined or questioned. Electromagnetics is a subject that is covered by excellent textbooks and studying from those is **by far** the best method to succeed in the course: **IF YOU WERE TO ATTEMPT TO STUDY AND PASS THE FINAL EXAM BY USING ONLY THE POWERPOINT HANDOUTS YOU WOULD LIKELY FAIL THE COURSE.** THEREFORE, THIS YEAR, I WILL NOT BE PROVIDING COPIES OF THE SLIDES.

I am providing a very detailed course plan that specifies precisely what you are supposed to learn, know, and what the exams and quizzes will cover. If you follow the plan AND practice doing problems and assignments, you will get a very good grade for this course. A “cheat” sheet with all the necessary formulas will be provided for the quizzes and exams. **THE GOAL IS NOT TO MEMORIZE FORMULAS AND CONCEPTS BUT TO UNDERSTAND THEM AND TO BE ABLE TO USE THEM.**

It is **HIGHLY** recommended to bring a notebook to class, as I will be providing a lot of information verbally and will be solving example problems on the black (green?) board.

Web site: This document, as well as many other important course related documents, will be posted on cuLearn. I will be using cuLearn to broadcast various announcements about the course (you will get these messages through your “connect” email accounts. **Make sure you re-direct those to the email account that you use daily, if needed**). You can also reach me through my Carleton email (not DOE).

Office hours, Teaching assistants and their coordinates:

I will be in my office during office hours, but I am also available at many other times if you take appointments via email (jacques_albert@carleton.ca). You can also take a chance and drop by the office (or lab, MINTO 5041). **DO NOT BE SHY, I LIKE HELPING STUDENTS...**

There will be 4 Teaching assistants for the course. They are listed below, with their contact information.

Alzenad, Mohamed	mohamedalzenad@cmail.carleton.ca
AlaviRad, Seyed Mohammad	SeyedMohammadAlaviRa@cmail.carleton.ca
Ouassal, Hassna	HassnaOuassal@cmail.carleton.ca
Kuiper, Ryan	RyanKuiper@cmail.carleton.ca

PROFESSIONAL ENGINEERING ACCREDITATION REQUIREMENTS :

New system:

CEAB graduate attribute content** (content code):	1 KB	2 PA	3 Inv.	4 Des.	5 Tools	6 Team	7 Comm.	8 Prof.	9 Impacts	10 Ethics	11 Econ.	12 LL
	IDA	IDA	IA	IDA			A					

I	Introduced	KB	Knowledge base
D	Developed	PA	Problem Analysis
A	Applied/used	Inv.	Investigation
		Des.	Design
		Comm.	Communications

As a result, you will be tested on all these attributes, not just knowledge and problem solving.

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, economic, environmental, cultural and societal considerations.
7. Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include 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.

Main consequences : Your assignments, quizzes, and exam will have to test all these aspects and will look « different ».

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."