ELEC 4503 COURSE OUTLINE Fall 2022

Radio Frequency Lines and Antennas

Introduction to distributed circuits, traveling and standing waves, reflection coefficient, SWR, impedance transformation, Smith charts. Introduction to transmission lines; coaxial, rectangular waveguide, resonators, optical fibers. Introduction to antennas; gain, directivity, effective area. Introduction to linear arrays.

Prerequisite: ELEC 3909.
Lectures: Twice a week: Tuesday and Thursday 8h35-9h55am (in-person only)

Laboratory Session: three hours every alternate week.
Instructor: Shulabh GUPTA, shulabh.gupta@carleton.ca
Office hours: email for appointments, flexible timings.
Teaching Assistant: Mohamed K. Emara (mohamedemara@cmail.carleton.ca)

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 Fall term. Rules for a missed final exam are covered in Carleton's undergraduate calendar.
- Final exam will be 3 hour written closed-book exam.
- 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 Labs: weight 20% of the final grade

- There will be total 6 labs sessions, three hours long every alternate week. However, only Four (4) will have lab reports to be graded.
- The complete lab reports must be submitted within 1 week of the date of labs.
- The lab reports must be prepared and submitted in electronic format, directly on BrightSpace submission page before the deadline.
- Ansys Electronics Desktop's **High Frequency Structural Simulator (HFSS) and Keysight Advanced Design System (ADS)** are the only softwares that will be allowed in this course, unless otherwise stated.
- The lab report must be submitted by **each** student for each of the graded lab. This report should include the measurement setup, a clear description of the measurement performed, data, sample calculations, discussion of results and conclusions.
- Unless otherwise mentioned, the measured lab results by each group, must be compared with the simulation results from HFSS/ADS, and must be included in your lab reports, as per the report guidelines
- The lab reports must be **submitted as a pdf file, in standard two-column IEEE format** prepared using **Latex only**. There will be a maximum page limit specified in each of the report guidelines. No hand-written reports or hand-drawn illustrations will be accepted.
- Missing a lab without justified reason, will result in an automatic zero for that lab.
- The document will be judged based on clarity, organization, logic, presentation and professionalism (including plagiarism aspects).

1 Midterm: total weight of 20%

- Midterm will held during regular lecture hour on **November 3, 2022.**
- No shows on the midterm is an automatic zero.
- Midterm will be returned with feedback after markings.
- Exam will be divided into 2 parts: **Multiple Choice** and **Subjective Questions**. Instructions to complete the exam will be clearly mentioned in the exam itself. The focus will be to test your theoretical understanding.
- It will be a **timed, open book in-person exam**.
- No discussions between students allowed. Any evidence of discussions, cheating, or something similar, during both the final exams or midterms, will have serious consequences.

HFSS/ADS Exam: total weight of 10%

- Last lab session will be reserved for an online exam on Ansys HFSS and/or Keysight ADS (3 hours long).
- A modeling problem will be assigned and the students are expected to design and simulate it in real-time using HFSS/ADS, and prepare a real-time report which will be graded.

Satisfactory performance to pass the course:

1- Minimum term grade of 50% AND
2- Minimum grade of 50% in final exam.

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

2. 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.

3. Textbooks and other learning resources

There are no official textbook for this course. I will be occasionally uploading relevant materials on CuLearn as the course progresses. However, some suggested textbooks covering the course contents are:

1. Branislav M. Notaros, “Electromagnetics,” (Prentice Hall, 2011).
2. David M. Pozar, “Microwave Engineering”, 4th Edition, Wiley.
3. M. Sadiku, “Elements of Electromagnetics”, 6th edition.
4. Saleh and Teich, “Fundamentals of Photonics”, 2nd Edition, Wiley.

I will be using slides in classes. Additional material will be used to reinforce the understanding. Several many 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.

4. 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.

5. 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."

6. COVID Protocols

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols.

Masks: Carleton has paused the COVID-19 Mask Policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the University's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.