PHYB21S-2022: Electricity & Magnetism

Course Instructor:

Prof. Salam Tawfiq Office: SW-517 Tel: 416-287-7243

e-mail: salam.tawfiq@utoronto.ca

Course Meeting Times

Lectures: 2 hours / week & Tutorial: 1 hour / week

Two-hour lectures on Monday (Synchronous 10 to 12 on ZOOM) & the Tutorials are Asynchronous).

Office hours: Tuesday 13.00-14.00 and Thursday 11.00-12.00

Textbook and References

Introduction to Electrodynamics, by ***David J. Griffiths,*** 3rd or 4th edition *(Prentice Hall).*

This book is one of the best-written books in this subject. Most students like the language and the style of the book. We will follow the book very closely, any material, which is not covered in the book will be delivered by the instructor and posted on Blackboard.

References:

Edward M. Purcell, Electricity and Magnetism, Second Edition (McGraw-Hill) (Different approach than Griffiths).

G. Pollack and D. Stump, Electromagnetism, Addison-Wesley, 2002.

Course Objectives

The primary objective of the course is for students to gain a working knowledge of electric and magnetic fields, potentials, and their sources using the language and tools of mathematics and to obtain physical insights into their behavior. More detailed objectives are listed below:

Understand and use vector algebra and calculus, including the del operator, gradient, divergence, and curl of vectors, as well as volume, surface and line integrals, to solve a variety of problems in electrostatics, magnetostatics, and electrodynamics.

Apply the above techniques to different coordinate systems, such as the Cartesian, cylindrical, and spherical coordinate systems. Therefore, students gain a working knowledge of other useful mathematical tools that will aid in solving a variety of problems in the course.

Understand and calculate static charge, Coulomb's law, electric fields, and potentials. Examples involving direct integration and Gauss's law will be studied, and applications using energy and capacitance will be investigated.

Develop an understanding of magnetostatics that includes the Lorentz force law, currents, magnetic fields, the Biot-Savart law, Ampère's law, and the magnetic vector potential. Examples and applications involving direct integration and Ampère's law will be studied.

Develop the concepts of electromotive force and Ohm's law. Understand electromagnetic induction and Faraday's law and apply these to inductors and energy in magnetic fields.

Derive Maxwell's equations and use them to solve problems in electrodynamics. Develop these equations for use in materials and apply the appropriate boundary conditions.

Academic Expectations: Collaboration

Attendance and Participation is expected to be mandatory where students are encouraged to attend for both tutorials and lectures, which is very important to better understand the material covered.

Adhering to high standards of academic integrity is an important part of your undergraduate experience. The standards are obvious when it comes to exams. Collaboration, such as working with others to conceptualize a problem, define approaches to the solution, or debug code, is often a gray area, and faculty in different courses may have different approaches to this issue.

In this course, discussion is allowed as long as it is identified. Plagiarism, such as copying someone else's solution or from other sources, such as Internet, is not allowed. The write-ups must always be your own. Modifying someone else's Assignment to make it your "own" is unacceptable. In case of doubt, consult the course instructor.

If you choose to collaborate with other students on the homework problems, indicate their names and the nature of your joint work. Ensure that your collaborator does the same on his/her assignment. A useful discussion of these issues may be found at http://ctl.utsc.utoronto.ca/home/integrity.

Technical Requirements for Remote and Online Learning:

Please review the Recommended Technology Requirements for Remote/Online Learning located on the following UofT webpage.
https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/

Specifically for our course you will need a fast and reliable Internet connection. This is particularly important for all the scheduled synchronous course components, including practicals, tests, and the final exam. Use of a computer (laptop or desktop) instead of a mobile device (smartphone or tablet) will be critical during all electronic forms of assessment. Additionally, you should connect via wire (Ethernet) to your modem or router instead of using a wireless (WiFi) connection to ensure stability and reduce interference. Lastly, you will be required to produce scans of handwritten work in PDF format for your practicals, tests, and the final exam. This can be accomplished using a dedicated scanner or using the camera in your

smartphone after installing a document scanner app. More details and suggestions will be provided in the course website.

Submitting PDF files

Submitting you Assignments, or during tests & Exam you will need to submit your file in PDF format, and you need to follow the following format in naming the file. The completed file should be digitized using a scanner, a mobile phone or other photographic devices. **Make sure it is properly focused and readable.** Name the file in the format **lastname_initial_test-1.pdf**. For example, my full name is Tawfiq Salam, so the filename for test-1 should be ***Tawfiq_S_test-1.pdf***. Please submit your scripts as a **single file** in pdf format. To submit your answers, you could navigate to **Grades >> Test-1 >> Attach File >> Browse >> Save >> Submit Assignment**. Make sure that you can preview your submission afterwards, and whether the words are legible. Be sure to submit your work **before the deadline**, otherwise the work will be considered late and will not be accepted. Your TAs will be strict on this and will not accept any late or other non pdf format, i.e. you could get a ZERO. Please be diligent and prepare your weekly practical, Tests and Exam **single files in time, in pdf format and named properly.**

Assignments, Tests & Exam. (online)

- There will be two midterm Tests to be held according to the Registrar's schedule.
- There will be 5 to 6 problem sets during the semester with 4 to 5 problems in each Assignment and three chosen problems will be graded.
- You will work on problems during the tutorials every week.
- During the last two weeks (exam period, as set by Registrar's office) there will be a comprehensive final exam, which covers all the material.

Assignments, Tests & Exam Policy & Submission Checklist

1. Problem set Assignments (and tests) will be submitted by student online on Quercus within the due date posted. There will be a penalty of 50% after the first 10 minutes and a zero will be assigned after that. Please do not wait for last minute & submit your Assignments (Tests) before due date as technical submission problems might arise.
2. Name the submitted file (for Assignments, Tests & Exam) in the format described above, i.e.lastname_initial_HW-1.pdf (for example).
3. The instructor reserves the right to send the assignment paper(s) to **plagiarism detection tool (PDT).** in case there is significant overlap with publisher notes, books, or solutions posted on the Internet, it will be a violation of the University of Toronto academic code.
4. Assignments are assigned about a week before due date. Therefore, to be fair with other students no excuses (including doctor notes) will be accepted for extension or not submitting the homework. So lutions will be posted right after the due date.
5. Each homework problem must be on a separate sheet of paper. If you need more than one sheet you should indicate this. The first page should be dedicated to the U of T honor pledge signed by the student, which is posted on Quercus.
6. You need to ***attempt*** all questions on the assignment though only 3 questions will be graded from each problem set. Missing any problem mean 20% deduction will be

applied. Show the marker that you genuinely attempted to solve the problem; it is fine if it was not correct.
7. When collaborating, please be sure to write the name(s) of those you discuss with on the top of your homework, missing this could be considered an academic offence.

> ***Note that collaboration is not copying someone's answers after changing letters or sharing code files if you write a program. It is discussing concepts and asking questions to help clarify your own difficulties with the problem***.

For all graded problems, in addition to any mathematical work, we expect clear written statements at each stage in the solution. Full marks will not be awarded without this. Another problem that sometimes arises is that of legibility. It takes a lot of time to grade problems for the marker. You will likely be more successful on your problem sets if you do what you can to not frustrate the marker. Please put some effort into ensuring that your work is clearly written.

In case some problem sets require the use of computers for visualizing a solution, which is very informative sometimes. Programming with Python, Mathematica (or MATLAB) is not an end but a means to investigate more complex phenomena using visual, analytic, and numerical methods. The code itself is not an adequate solution to the problem; you must interpret your results and answer the questions posed. You should approach the problem with the goal to understand and explain the physical phenomena investigated and the behavior of the system for variations of the parameters.

Grading:

ACTIVITIES	PERCENTAGES
Problem sets	24%
Two Midterm tests	30% (15% each test)
Final exam	46%
Note: ***No make-up tests in this course***, if you miss test-1, for acceptable documented reasons, then test-2 will worth 30%, however, if you miss test-2 your final exam worth 60%	

Syllabus:

The tentative calendar below provides information about the Topics covered in this course. This schedule follows the textbook "***Introduction to Electrodynamics***, by ***David J. Griffiths"***. However, you may use other books that cover the same topics.

CHAPTER #	TOPICS	
Chapter-1	Vector Analysis	Week-1 & 2
Chapter-1	Differential Calculus	Week-3
Chapter-2	Electrostatic	Week-4
Chapter-2	Work and Energy in Electrostatics	Week-5
Chapter-5	Magnetic Fields, Lorentz Forces	Week-6
Chapter-5	Ampere's Law & Magnetic Vector Potential	Week-7
Chapter-7	Ohm's Law, Electromotive force & Motional EMF	Week-8
Chapter-7	Electromagnetic Induction, Inductance & Energy Stored in Magnetic Fields	Week-9 & 10
Chapter-7	Maxwell's Equations	Week 11

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Access*ibility* Services at UTSC as early as possible in the term. The Access*ibility* Services will determine reasonable accommodations for this course.

GOOD LUCK