PHYC50-2020: Electromagnetic Theory

Course Instructor:
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Course Meeting Times
Lectures: 2 hours / week & Tutorial: 1 hour / week (Monday 10:00 AM to 11:00 AM)
Office hours:  Monday 12.00-13.00 and Wednesday 12.00-13.00.

Course Description:
Solving Poisson and Laplace equations via method of images and separation of variables, multipole expansion for electrostatics, atomic dipoles and polarizability, polarization in dielectrics, multipole expansion in magnetostatics, magnetic dipoles, magnetization in matter, Maxwell’s’ equations in matter and Maxwell’s Stress Tensor.

Textbook and References:

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

This book, which was used with PHYB21, is one of the very well 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. You are encouraged to consult other books in the field, there are a number of those, and some are listed below.

References:
Edward M. Purcell, Electricity and Magnetism, Second Edition (McGraw-Hill) (different approach than Griffiths);


Course Objectives:
The primary objective of the course is for students to gain a working knowledge of electromagnetism including electric and magnetic fields, potentials, and their sources using the language and more advanced tools of mathematics to obtain physical insights into their behavior. Students will extend their knowledge in EM in free space to Electricity & Magnetism in materials.

How do boundaries affect the physics? How do different sources and geometries produce different field configurations? What energies are involved? How do we analyze magnetostatics? How is energy propagated in EM waves? Mostly for classical fields both in free space and in matter.
Academic Expectations & Collaboration:

Lectures will be delivered online; they will be recorded & posted on Quercus. You are encouraged to attend tutorial as there will be problems assigned to be solved by students, 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](http://ctl.utsc.utoronto.ca/home/integrity).

E-Mail: I will only respond to e-mails sent from a recognized University of Toronto address. Please put PHYC50 in the subject line of any course-related e-mails. Will try to respond within 24 hours during Monday to Friday. **We will not accept solutions to Assignments via e-mail only in special cases.**

Assignments, Tests & Exam

- 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.
- 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 Policy & Submission Checklist

1. Problem set Assignments will be submitted by student online on Quercus within the due date posted. There will be a penalty of 50% after the first 15 minutes and a zero will be assigned after that. Please do not wait for last minute & submit your Assignment before due date.
2. The Instructor reserve the right to send the assignment paper(s) to TURNITIN service in case there is significant overlap with publisher notes or solutions.
3. HomeWorks are assigned at least 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.
4. Each homework problem must be on a separate sheet of paper. If you need more than one sheet you should indicate this.
5. You need to attempt all questions on the assignment though only 2 or 3 questions only 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.

6. When collaborating, please be sure to write the name(s) of those you discuss with on the top of your homework.

Note that collaboration is not copying someone's answers 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 in itself 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:

<table>
<thead>
<tr>
<th>ACTIVITIES</th>
<th>PERCENTAGES</th>
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<tbody>
<tr>
<td>Problem sets</td>
<td>22%</td>
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<tr>
<td>Two Midterm tests</td>
<td>24% (Test-1: 12% &amp; Test-2: 12%)</td>
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<tr>
<td>Final exam</td>
<td>46%</td>
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<td>Tutorial/practical Participation</td>
<td>8%</td>
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Note: There is **No makeup 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

Calendar:
The tentative calendar below provides information about the Topics covered in this course. This schedule follows the textbook by *David J. Griffiths*. However, you may use other books that cover the same topics.
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<thead>
<tr>
<th>CHAPTER #</th>
<th>TOPICS</th>
<th>WEEK</th>
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<tbody>
<tr>
<td>Chapter-3</td>
<td>Review of Electrostatics &amp; Magnetostatics (first class), then Method of Images &amp; Laplace’s equation</td>
<td>Week-1</td>
</tr>
<tr>
<td>Chapter-3</td>
<td>Boundary Conditions &amp; Separation of Variables</td>
<td>Week-2</td>
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<tr>
<td>Chapter-3</td>
<td>Multipole Expansions &amp; Electric Field of a Dipole</td>
<td>Week-3</td>
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<td>Chapter-4</td>
<td>Polarization &amp; Dielectric</td>
<td>Week-4</td>
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<td>Chapter-4</td>
<td>Boundary Value Problems &amp; Energy and Forces</td>
<td>Week-5</td>
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<td>Chapter-6</td>
<td>Bound Currents &amp; Ampere’s Law in Magnetized Materials</td>
<td>Week-6 &amp; 7</td>
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<td>Chapter-7</td>
<td>Linear and non-Linear Media &amp; Inductance and Maxwell’s Equations</td>
<td>Week-8</td>
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<td>Chapter-8</td>
<td>Charge and Energy &amp; Poynting’s Theorem</td>
<td>Week-9</td>
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<td>Chapter-8</td>
<td>Momentum, &amp; Maxwell’s Stress Tensor</td>
<td>Week-10</td>
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<tr>
<td>Chapter-9</td>
<td>ELECTROMAGNETIC WAVES IN VACUUM (Time permitting!)</td>
<td>Week-11</td>
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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 AccessAbility Services at UTSC (ability@utsc.utoronto.ca) as early as possible in the term. They will determine reasonable accommodations for this course.

GOOD LUCK