PHYC50H

Electromagnetic Theory

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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, Ampere and Biot-Savart laws, multipole expansion in magnetostatics, magnetic dipoles, magnetization in matter, Maxwells equations in matter.

LECTURES:

Mondays 10am-11am and Wednesdays 10am-11am in room BV260.

TUTORIALS:

Tutorials are 50 minutes in duration, and will be held every Tuesday starting at 1510 from Week 2. Tutorials will be held in room SW505B.

Tutorial attendance is expected. In addition to problem solving examples that will support the lecture material, tutorials will feature quizzes that contribute to the final grade.

TEXTBOOK: D. J. Griffiths, *Introduction to Electrodynamics*, 3rd edition (Prentice Hall).

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

H.M. Schey, *Div, Grad, Curl and All That*, (Norton) (covers vector calculus in the context of electromagnetism);

M.R. Spiegel, *Schaum's Outline Series Theory and Problems of Advanced Calculus*, (McGraw-Hill).

E-Mail: Please put PHYC50 in the subject line of any course-related e-mails. I will endeavour to reply as quickly as possible to your e-mails. However, I cannot promise that I will do so outside of normal working hours (Monday-Friday 9-5). Please include your name and student number in any communications. I will not respond to emails if I cannot tell who they are from. Please also note that I will NOT accept assignments via e-mail.

OFFICE HOURS:

I will be available to answer questions on a drop in basis on Wednesdays between 11:30 and 12:30 in Room SW506H. If you are unable to attend these hours for timetable reasons you may arrange an appointment by e-mail. General questions regarding the lecture material will also be addressed in the Tuesday tutorial.

LECTURE SCHEDULE

SEPTEMBER 4
Laplace's equation in 1, 2 and 3D (3.1.1-3.1.4)

SEPTEMBER 9 and SEPTEMBER 11
Boundary Conditions, Uniqueness and Method of Images (3.1.5-3.2.3)
Separation of Variables (Cartesian) (3.3.1)

SEPTEMBER 16 and SEPTEMBER 18
Separation of Variables (Spherical) (3.3.2)
Multipole Expansions (3.4.1-3.4.2)

SEPTEMBER 23 and SEPTEMBER 25
Electric Field of a Dipole (3.4.2-3.4.4)
Polarization, Dielectrics(4.1.1-4.2.1)

SEPTEMBER 30 and OCTOBER 2
Bound Charges (4.2.1-4.2.2)
The Electric Displacement (4.2.3-4.4.1)

OCTOBER 7 and OCTOBER 9
Linear Dielectrics (4.2.3-4.4.1)
Boundary Value Problems (4.4.2-4.4.3)

OCTOBER 14 and OCTOBER 16
Thanksgiving
Study Break

OCTOBER 21 and OCTOBER 23
Energy and Forces (4.4.4)
Multipole Expansion of the Magnetic Vector Potential (5.4.3)

OCTOBER 28 and OCTOBER 30
Torques and Forces on Magnetic Dipoles (6.1.1-6.1.2,6.1.4)
Bound Currents (6.2.1-6.2.3)

NOVEMBER 4 and NOVEMBER 6
Ampere's Law in Magnetized Materials (6.3.1-6.3.3)
Linear and non-Linear Media (6.4.1-6.4.2)

NOVEMBER 11 and NOVEMBER 13
Electromotive Force and Induction (7.1.1-7.2.3)
Inductance and Maxwell's Equations (7.2.3-7.3.6)

NOVEMBER 18 and NOVEMBER 20
Charge and Energy, Poynting's Theorem (8.1.1-8.1.2)
Momentum, Maxwell's Stress Tensor (8.1.2-8.2.2)

NOVEMBER 25 and NOVEMBER 27
Angular Momentum (8.2.3-8.2.4)
Review Problems

ASSESSMENT:

A COMPREHENSIVE FINAL EXAM (3 hrs): 50%

MIDTERM TEST (90 minutes): 22%

4 ASSIGNMENTS (tutorial and take home work): 16% in total

3 TUTORIAL PRACTICALS/QUIZZES: 12% in total

TESTS AND EXAM:

Both the midterm and final exam will draw from lecture and tutorial materials. This could include material presented in the lectures or tutorial material that is not covered in the text. The chapters from the text that *support* the lecture material presented each week are indicated in the schedule above.

The Mid-Term test will cover the subject matter covered in weeks 1-6.

The final exam will cover all material.

NOTES:

Due dates and times will appear on the assignment handouts. Late assignments will be penalized by 50% per day. Assignments must be handed in at the tutorial on the day they are due. Assignments handed in later on the same day will be considered 1 day late. Each 24 hour period following from the end of the tutorial time slot is considered a day. Assignments that are more than one day late will not be accepted.

I expect that, in the course of doing your assignments, you will discuss them with your classmates at some level. This is fine, and a normal part of the study process. What you must not do, is copy another student's work. It is fine to discuss the problems, but when it comes to actually writing out your solutions you should do this by yourself. To copy answers from someone else is an academic offense. Plagiarism will not be tolerated. Students are expected to submit their own work for grading. Should you choose to disregard this advice, be aware that academic offenses will be turned over to the university for the determination of an appropriate penalty. I will not enjoy the process anymore than you so please don't put it to the test.

For all graded problems, in addition to any mathematical work, I 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 and effort to grade problem sets and it is very frustrating for the marker if assignments are messy and difficult to read. 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. And please staple the pages of your assignments together.