PHYB21H
Electricity and Magnetism

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COURSE DESCRIPTION:

A first course at the intermediate level in electricity and magnetism. The course provides an in-depth study of electrostatics and magnetostatics. Topics examined include Coulomb's Law, Gauss's Law, electrostatic energy, conductors, Ampere's Law, magnetostatic energy, Lorentz Force, Faraday's Law and Maxwell's equations.

LECTURES:

Mondays 10:10 am-12:00 pm EST, online - synchronous classes through Blackboard Collaborate.

TUTORIALS:

Tutorials are 50 minutes in duration, and will be held every Thursday starting at 10:10 am EST from Week 1 of the Summer term. Tutorials will be held as online - synchronous classes through Blackboard Collaborate.

Tutorial attendance is expected.

TEXTBOOK: D. J. Griffiths, *Introduction to Electrodynamics*, 4th edition (Cambridge University Press).

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 PHYB21 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 EST). 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:

Following the tutorial I will hold office hours in the same Blackboard Collaborate environment from 11:00 am to 12:00 pm (EST). For this session to run optimally, I strongly suggest posting questions you have on the discussion board (more details to follow) prior to office hours. This will allow me to see where assistance is needed and plan accordingly.

If you are unable to attend these hours for time table reasons you may arrange an appointment by e-mail. General questions regarding the lecture material will also be addressed in the Thursday tutorial.

LECTURE SCHEDULE

MAY 10
Vector Algebra (1.1.1-1.1.2)
Scalar and Vector Functions, Gradient (1.1.3-1.2.2)
Divergence, Curl, Product Rules (1.2.2-1.2.6)

MAY 17
Second Derivatives, Integrals with Vector Functions (1.2.7-1.3.5)
Divergence Theorem, Stokes' Theorems; Integration by Parts (1.3.4-1.3.6)

MAY 24
VICTORIA DAY

MAY 31
Spherical and Cylindrical Coordinate Systems, Delta Functions (Reference: 1.4.1-1.4.2)
Delta Functions, Theory of Vector Fields (1.5.1-1.6.2)

JUNE 7
The Electric Field, Coulomb's Law, Electrostatics (2.1.1-2.1.4)
Divergence of Electrostatic Fields, Gauss's Law (2.2.1-2.2.3)

JUNE 14
Curl of Electrostatic Field, Electric Potential (2.2.4-2.3.4)
Electrostatic Boundary Conditions, Work and Energy (2.3.5-2.4.1)

JUNE 21
Work and Energy in Electrostatics (2.4.1-2.4.4)
Conductors (2.5.1-2.5.3)

JUNE 22 to JUNE 26
READING WEEK

JUNE 28
Capacitance (2.5.4)
Magnetic Fields, Lorentz Forces (5.1.1-5.1.2)

JULY 5
Currents, Biot-Savart Law (5.1.3-5.2)
Divergence and Curl of **B**, Ampere's Law (5.2.1)

JULY 12
Ampere's Law cont'd (5.3.1-5.3.3)
Magnetic Vector Potential (5.4.1-5.4.3)

JULY 19
Magnetostatic Boundary Conditions (5.4.2)
Ohm's Law, Electromotive force, Motional EMF (7.1.1-7.1.3)

JULY 27
Electromagnetic Induction, Induced Fields (7.2.1-7.2.2)
Inductance, Energy Stored in Magnetic Fields (7.2.3-7.2.4)

AIGUST 2
CIVIC HOLIDAY

AUGUST 9
Maxwell's Equations (7.3.1-7.3.3)
Extra lecture or tutorial, if required

ASSESSMENT:

A COMPREHENSIVE FINAL EXAM (3 hrs): 50%

2 TERM TEST (90 minutes each): 34%

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

TESTS AND EXAM:

Both the term tests 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 term tests will include the subject matter covered in weeks 1-4 and 1-8.

The final exam will cover all material.

NOTES:

One of the main problems students seem to have when taking electromagnetism for the first time arises because much of the mathematics is unfamiliar to them. The study of electromagnetism requires the use of multi-variable calculus and vector calculus. While you will likely be doing multi-variable calculus concurrently, in your second-year calculus course, you may not see vector calculus there before you see it (and need it) in this course. For that reason, the first month or so of PHYB21 is very important. We will not do this in the same depth that you would see in a mathematics course, but we will cover everything that you will need for the rest of this course. The first assignment will be entirely on Chapter 1 of the text, which deals with this material. It is very important for you to ensure that you are as comfortable as possible with this material by the time we begin Chapter 2.

Due dates and times will appear on the assignment handouts. Late assignments will be penalized by 50% **per day**. Assignments must be handed in during class on the day they are due. Assignments handed in later on the same day will be considered one 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. When submitting assignments online through the Quercus environment, ensure that you are submitting a single PDF document of appropriate resolution. More will follow regarding proper assignment submission as we approach those dates.