PHYS 2326 – Electromagnetism and Waves
Spring 2009

INSTRUCTOR:

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TEACHING ASSISTANT:

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OFFICE HOURS:

- **Dr. Anderson: Tuesday/Thursday 12:00 – 1:30 PM and by appointment**
- **Mr. Zhang – Friday 3:00 – 5:00 PM**

Required Textbooks and Materials:

Our official textbook will be "**University Physics (12th edition, if you have an older edition – contact me) by Young&Freedman**. Make sure that there is a "**Student Access Kit**" with your book. It allows you the free access to the homework website through which you will do your HW. It is important to have.
Any mentioning of a chapter will refer to this book, you need to have at least volume 2 (E&M). If you want to use other textbooks – you are free to do so, but you will have to find the required chapters for reading by yourself. Similar books are:
1) "Fundamental of Physics" Halliday, Resnick &Walker
2) "Physics for Scientists and Engineers" R. Serway and R. Beichner

Suggested Course Materials :

For those who want a step further in understanding of physics phenomena and E&M in particular, you may look through "The Feynman Lectures on Physics", vol. 2, any edition. I will be glad to discuss any material from that book with you during office hours.

You must register for the homework web site, www.masteringphysics.com. User ID for this class is MPANDERSON87713. You will need software called "Flash" to be installed on your computer.

Slides:

Slides will be available on the web at: www.utdallas.edu/~pca015000

Follow the links to each class's notes (at www.utdallas.edu/~pca015000)

In-class participation:

With this syllabus, you will find 2 pages of "flash cards". These will be used in class to find out the level of understanding in the class about the current topics. I will give an example with multiple choices for the answer and you will hold up the flash card corresponding to the answer.

Course Pre-requisites, Co-requisites, and/or Other Restrictions:

PHYS 2325 (Physics I), MATH 2419 (Calculus I) or consent of instructor

Course Description:

Introduction to concepts of electromagnetism. Electric charge, Coulomb's law. Concept of electric field. Superposition of fields. Gauss's law. Electric potential. Capacitance, potential energy of electric charges and of E-field. Dielectrics. Model of induced charges. DC Electric circuits, electric current. Electric power and energy in circuits. Resistors, Batteries, Electromotive force. Kirchhoff's rules. AC current. Magnetic forces and Magnetic field. Motion of charges in magnetic field. Electromagnetic induction. Ampere's law. Faradays' law. Displacement current. Inductors. Lenz' law. Electromagnetic waves. Maxwells' equations. Introductory optics. Reflection and refraction. Image formation. Wave superposition. Interference.

Student Learning Objectives/Outcomes:

During the course activity, students will learn basic principles underlying electromagnetism and related disciplines. Students will learn how to apply such principles to problem solving. Some examples of learning objectives are:

- Students will be able to calculate the force on a charged particle that is placed in between the plates of a parallel-plate capacitor.
- Students will use Coulomb's law to describe the effects of static charge on nearby materials
- Given a diagram of a "slide wire" generator, students will use Faraday's and Lenz laws to find the electromotive force generated.

Course Description:

This brief high-level description is intended to give a glimpse of some of the subjects we will be talking about (not necessarily in the same order and to different depths).

INTRODUCTION

Electric charges and fields; Properties of electric charges; Coulomb's law and superposition; Conductors and insulators; Magnetic fields and Lorenz force; What Maxwell equations look like.

MATHEMATICS OF VECTOR FIELDS

Vectors, their scalar and vector products; Scalar and vector fields; Flux of vector fields and line integrals; Del operator, gradient, divergence and curl.

ELECTROSTATICS

Gauss' law and electric filed lines; Electric potential and Poisson's equation; Potential and fields of continuous charge distributions; Earnshaw's theorem (instability of equilibrium in electrostatic

fields); Conductors and insulators in electric fields; Method of images; Polarization of dielectrics; Capacitance and capacitors; Electrostatic energy.

ELECTRIC CURRENT AND DC CIRCUITS

Current and current density; Ohm's law; Conductivity in metals, insulators and semiconductors; Superconductors; Electrical energy and dissipation; Combinations of resistors; Kirchoff's rules; RC circuits.

MAGNETOSTATICS

Magnetic forces on and between current elements; Biot-Savart and Ampere's laws; Magnetic fluxes and field lines; Solenoids; Magnetostatic energy and inductance; Magnetization and magnetic materials.

MOTION OF CHARGES IN ELECTRIC AND MAGNETIC FIELDS

Cathode ray tube (CRT); Mass-spectrometers and cyclotrons; Crossed electric and magnetic fields: Hall effect.

TIME-DEPENDENT FIELDS AND CURRENTS

Faraday's and Lenz's laws; Induced emf and electric fields; Generators and motors; Self inductance and mutual inductance; Conservation of charge and displacement current; RL and LC circuits.

MAXWELL EQUATIONS AND ELECTROMAGNETIC WAVES

Maxwell equations and their plane wave solutions; Hertz's experiments; Energy and momentum of electromagnetic waves; Antennas; Spectrum of electromagnetic waves; Polarization, reflection, refraction and interference of electromagnetic waves.

GRADING:

- **Exams (3)**

  2 Exams (Feb 12, Mar 26) @ 20% each = 40%
  Final Exam (May 7 @ 8am) = 25%
  40% of the final will be comprehensive

- **Short quizzes = 10%**

  The worst two grades will be dropped

- **Homework = 25%**

Homework assignments are assigned approximately every two lectures and are due in a week. The completion of HW is absolutely necessary. If HW is not done in time, the score will start to decrease. If you cannot make it in time, you must contact me in order to discuss your problems. Reading assignments are indicated during the lecture sessions. It is important to read the book as it will go into more detail than I can go into in class and may approach the subject from a different direction. It will also have more examples that will help you understand the concept.