Physics 212 – Physics for Science and Engineering II: Electrodynamics – University of Mississippi

In classical mechanics one seeks to relate forces acting on a body to the motion of that body. With Newton's laws, one was able to predict the future position of a body, given the current position and speed. Oftentimes, the force responsible for the push to move a body is its own weight force. One may ask: nothing is attached to the body, so where is the push or pull? This is certainly a valid question. The answer is that a body knows of the presences of another massive body, by interacting with the body's gravitational *field*. Newton had no such concept, rather he considered a so-called *action at a distance*. He assumed that a massive body A knew of a massive body B instantaneously across some vast distance with nothing mitigating the push or pull. A body establishes a *field* round it, with changes (information) in that field moving at some finite speed. The goal of this course is to develop an understanding of the *electromagnetic field*, beginning with the famous Coulomb's and Biot-Savart laws and then moving on to the equations of the electromagnetic field, the *Maxwell equations*. Along the way we discuss circuits and other applications of these ideas. Why is this important? It turns out, that most interactions in Nature are electromagnetic in origin. Normal, friction and elastic forces are electric in origin. Interactions between molecules in gases and liquids are also electric in origin. The applications are indeed vast. Given this, such a course is often far more challenging then a course in mechanics. The ideas and mathematics require a greater effort to grasp.

Class sessions should be discussions, meaning that *all of us* contribute, and your equal (active) contribution of questions, comments and insights are expected. Historically, text readings are: (a) beneficial and (b) most beneficial if done before the class, with review after. Problem sets will be collected and evaluated. In addition, problems, often derivations, will be assigned in class and collected.

Text: *Physics for Scientists and Engineers* by Serway and Jewett.

Suggested References:

- *The Feynman Lectures on Physics, vol. 2* by R.P. Feynman
- *Modern University Physics* by Richards et al.

Class Sessions: Monday through Friday in room 109 of Lewis Hall. Class time to be determined.

Office Hour: Most evenings (6:00 to 8:00) at High Point Coffee on square and by arrangement.

Cumulative Course Examination: Date to be announced.

Grading Scheme:

Evaluation will be based on frequent problem sets and a course examination. The final mark, say M, is given by

$$M = 0.6 \cdot E + 0.4 \cdot P,$$

where E is the mark of the course examination and P is the cumulative mark of the problem sets.

Letter Mark	Numerical Mark
A	$85 - 100$
$A-$	$80 - 85$
$B+$	$75 - 80$
B	$60 - 75$
$B-$	$55 - 60$
$C+$	$50 - 55$
C	$35 - 50$
$C-$	$30 - 35$
D	$20 - 30$
F	$0 - 20$

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Lecture Plan:

- *Introduction*
- *Electrostatics*
  - Coulomb's Law
  - The Electric Field
  - The Electric Potential
- *Currents and Circuits*
- *Magentostatics*
  - The Magnetic Field
  - Magnetic Forces
- *Time Varying Phenomena*
  - Induced Electromotive Force
  - Capacitance
  - Inductance
  - Alternating Currents and Electromagnetic Waves
- *Optics*
  - The Nature and Propagation of Light
  - Reflection and Refraction
  - Lenses
  - Interference and Diffraction
  - Polarisation