Physics-306 (142)
Homework Set (2)

The main objective of this problem set is for you to review what you studied in earlier Electricity and Magnetism courses

This set is due by Thursday 30th of Rabi-II, 1436 (February 19th, 2015) at 10.00 p.m. (*).

In *all homeworks*, please solve *fully* and *clearly*, *state assumptions*, and *comment* wisely (when applicable).

Please circle your final answer, and identify which of the multiple choices is the correct answer.

Do not consult with your fellow students in this problem set

I wish you well, wa assalam alaikum!!

Zain Yamani
Phys-306 Instructor

(*) slip it under my Office door, in 15-3100

Question-1:
Argue in favor of Ohm's law [$\mathbf{j} = \sigma \mathbf{f}$] though, according to classical mechanics, a constant force on a charged particles does not result in a steady current density!

Question-2:
Describe eddy currents, and present video links that demonstrate them; explain their effect in real-live technology, good or bad.

Question-3:

a- Is it accurate to say that the magnetic field in a 'motional emf' system does work on the charges to get them going? Elaborate.
b- Prove that the flux rule applies even for non-rectangular loops moving in arbitrary directions through possibly non-uniform magnetic fields, and even if the loop does not maintain a fix shape with time!

Question-4:

a- State Neumann formula for mutual inductance, and explain what it describes.
b- Resolve the paradox related to the mutual inductance between two ideal long coaxial solenoids: a varying current in the inner solenoid should induce an emf in the outer solenoid though the magnetic field due to the long inner solenoid vanishes at the outer solenoid regardless of current!

Question-5:
Find an expression that relates the energy stored in a magnetic field with:

a- The self inductance and current
b- The vector potential and current density
c- The vector potential and magnetic field

Question-6:
Solve problem 7.41, from your textbook

Question-7:
Solve problem 7.51, and find the angular frequency for a *typical* loop. State assumptions clearly, as always ☺.

<u>Do not consult with your fellow students in this problem set</u>