ENEE 381, Spring 2004. Homework Set 1

Due February 12, 2004

(1) Cheng Problem 6-15

(2) Cheng Problem 6-17

(3) Cheng Problem 6-18

(4) A circular coil of radius 100mm with 100 turns rotates about a vertical diameter at an angular velocity of 100 rad/s in a uniform horizontal magnetic flux of 0.01T. The resistance of the coil is 5ohm. Calulate the current induced in the coil and the energy dissipated in it. A small compass needle, which is free to move, is mounted at the center of the rotating coil. Calculate the angle with respect to the external flux direction at which it comes to equilibrium.

(5) A single electron is moving in the z-direction with velocity 10^6 m/s along the line $x = y$=1mm. The electron crosses the plane z=0 at $t = 0$. Plot the variation in electric field amplitude at the point (0,0,0) from t=-10ns to t=10ns.

Now, suppose that an infinite continuous line of electrons is moving in the same way, with a uniform spacing between electrons of 1mm. Show the variation in electric field from t=-10ns to t=10ns. What is the magnetic field $\mathbf{H}$ at the origin (0,0,0)?

(6) A circular metal disk of diameter 500mm rotates at 1000 rpm about a vertical axis in a vertical magnetic flux of 0.1T. See for example Cheng Example 7-3. What is the voltage generated beteen the axis and perimeter of the disk along a radius?

(7) The current in a region of space $\rho \leq$5mm is $\mathbf{J} = 10e^{-10^5\rho^2}\hat{\mathbf{z}}$. Use the magnetic potential vector to give expressions for the magnetic field everywhere.

(8) A positive charge q moving with velocity $\mathbf{v} = v\hat{\mathbf{k}}$ enters a region of space where there is a uniform magnetic flux $\mathbf{B}$=$B_0\hat{\mathbf{j}}$ and a uniform electric field $\mathbf{E}$=$E_0\hat{\mathbf{i}}$. Write down the equations of motion of the charge and calculate its trajectory.