Homework 4
Due at the beginning of class Feb. 5

1. Derive an integral expression for the magnetic field at an arbitrary point from a uniformly charged spherical shell which is rotating with angular velocity ω.

2. A toroidal coil (donut shaped electromagnet), symmetrically located in the x-y plane, carrying current I_0 generates a magnetic field. Derive an integral expression for its magnetic field at an arbitrary point.

3. A steady current I flows down a long cylindrical wire of radius a. The current is distributed in such a way that $\vec{J}$ is proportional to the distance from the center of the axis or center of the wire. Find the magnetic field both inside and outside the wire. .

4. Two long coaxial solenoids with n_a and n_b turns per length each carry current I, but in opposite directions and are of radi a and b with $a < b$. Find $\vec{B}$ inside the inner solenoid, between them, and outside both.

5. Which of the following is not an electrostatic field? Justify your answer. (a) $\vec{E} = xy\hat{x} + 2yz\hat{y} + 3xz\hat{z}$ (b) $\vec{E} = y^2\hat{x} + 2(xy + z^2)\hat{y} + 2yz\hat{z}$.

6. Compute the line integral of $\vec{V} = 6\hat{x} + yz^2\hat{y} + (3y + z)\hat{z}$ along the triangular path in the yz plane with vertices at the orign and z=2, y=0 and z=0, y=1. Check your answer using Stokes theorem.

7. Derive an integral expression for the voltage at an arbitrary point from a disk of radius R symmetrically located in the x-y plane with $\sigma = \sigma_0 \cos\phi$. Assume that the potential at infinity is zero.

8. Explain how you would determine the electric field for the charge distribution in the pervious problem.