IIITDM Kancheepuram

Assignment-2 (PH1000), Max. Marks: 10

1. (i) A charged particle enters the electric and magnetic fields such that the electric (E) and magnetic (B) fields point in z and x directions, respectively. The charged particle enters the fields at origin with the initial velocity $\frac{\mathbf{E}}{\sqrt{2}\,\mathbf{B}}\,(\vec{y}+\vec{z})$.

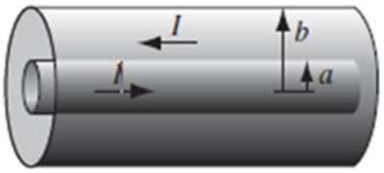
(ii) The Ampere law in magnetostatics is expressed as Curl H = J. However, if we use the expression for H in case of a straight current carrying wire, then Curl H = 0. Resolve the contradiction.

2. (a) Find the vector potential a distance 'r' from an infinite straight wire carrying a current I. Check that divergence(A) = 0 and curl(A) = B.

(b) Find the magnetic potential inside the wire, if it has radius 'R' and the current is uniformly distributed.

3. A coaxial cable consists of two very long cylindrical tubes, separated by linear insulating material of magnetic susceptibility χ_m. A current I flows down the inner conductor and returns along the outer one; in each case, the current distributes itself uniformly over the surface. Find the magnetic field in the region between the tubes. As a check, calculate the magnetization and the bound currents, and confirm that (together, of course, with the free currents) they generate the correct field.

4. A coaxial cable consists of two very long cylindrical tubes, separated by linear insulating material of magnetic susceptibility χm. A current *I* flows down the inner conductor and returns along the outer one; in each case, the current distributes itself uniformly over the surface. Find the magnetic field in the region between the tubes. Calculate the magnetization and the bound currents.



5. A fat wire, radius *a*, carries a constant current *I*, uniformly distributed over its cross section. A narrow gap in the wire, of width $w << a$ forms a parallel-plate capacitor, as shown in Figure below. Find the magnetic field in the gap, at any distance $s < a$ from the axis.