Department of Physics, Bennett University

EPHY105L (I Semester 2021-2022)

Tutorial Set-7

1. **Consider an infinitely long cylinder of circular cross-section of radius a which is uniformly magnetised parallel to its axis.**
   (a) Obtain the bound surface and volume currents.
   (b) Obtain the magnetic field produced by the magnetised cylinder.

2. **An infinitely long straight wire made of copper and of radius R carries a current I which is uniformly distributed across its cross-section. Using Ampere's law obtain the values of the fields $\vec{H}$ and $\vec{B}$ within and outside the wire. What are the bound surface and volume currents?**

3. **A coaxial cable consists of two very long cylindrical tubes separated by a linear insulating material with magnetic susceptibility χ_m. If a current I flows along the inner tube and returns along the outer tube, find the magnetic field in the region between the two tubes.**

4. **Consider an infinitely long solenoid with circular cross-section of radius R having N turns per unit length and carrying a current I. If a cylindrical rod of radius $a < R$ and made of a material of magnetic susceptibility χ_m is placed coaxial within the solenoid, calculate the magnetic field $\vec{B}$ and the field $\vec{H}$ in different regions within the solenoid. What are the values of bound surface and volume currents?**

5. **An infinitely long wire and a square conducting loop of side a are placed in a plane with one side of the square loop being parallel to the wire. The loop is moving away from the long wire at a speed v. If a current I flows through the wire, calculate the magnitude of the induced emf in the loop at an instant when the nearest side of the square is at a distance b from the wire.**

6. **A coil consisting of 100 turns of radius 20 cm is placed perpendicular to a uniform magnetic field of 0.5 T. Calculate the emf induced in the coil in 0.2 s if**
   (i) the field is reduced to zero,
   (ii) the field is reversed in direction and
   (iii) the coil is rotated through $90°$.

7. **Consider a long hollow solenoid of radius $R = 2$ mm and length $L = 20$ cm having a total of 100 turns. If an alternating current of amplitude 5 A and frequency $f = 10$ kHz is passed through the coils, find the magnitude of the induced electric field inside the solenoid. What will be the direction of the electric field?**

8. **Consider an infinitely long solenoid of radius 1 cm and having 1000 turns per meter. The current in the solenoid is increased linearly from zero to 1 A in 1 ms. Calculate the magnitude of the induced electric field at**
   (i) a distance of 2 mm from the axis and
   (ii) a distance of 2 cm from the axis.