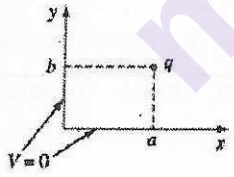
(c) Moist soil has a conductivity of 10^{-3} **S/m** and relative permittivity **2.5**. Find J_c and J_D where $E = 6 \times 10^{-6} \sin(9 \times 10^9 t)$ **V/m** (3)

5. (a) Two infinitely long grounded metal plates at y=0 and y=π are connected at x=+a and x=-a by a metal strip maintained at potential V_0. Find the potential inside the rectangular pipe for V=0 when y=0 & y = π and $V=V_0$ at x = +a & x=-a. (12)

(b) What is the significance of Maxwell's displacement current, and how is it different from conduction current? (3+3)

6. (a) Two semi-infinite grounded conducting planes meet at right angles. In the region between them there is a point charge q. Find the location and magnitude of all image charges. (9)



(b) An infinitely long circular cylinder carries a uniform magnetization M parallel to its axis. Find the magnetic field inside and outside the cylinder. (9)

(2500)

[This question paper contains 4 printed pages.]

Your Roll No.

Sr. No. of Question Paper : 1225

Unique Paper Code : 2222011202

Name of the Paper : Electricity and Magnetism

Type of the Paper : DSC

Name of the Course : **B. Sc. (H)**

Semester : II

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Question 1** is compulsory.
3. Attempt **any four** questions from question numbers 2-6.
4. All questions carry equal marks.

1. Attempt **all** parts of this question: (6×3=18)

(a) Find the electric field at the centre due to a uniformly charged semi-circular arc.

P.T.O.

(b) Find the potential for the region between two concentric right circular cylinders when $V_1 = 0$ at V at r = 1 mm and V_2 =150 V at r = 20 mm.

(c) What is the interpretation of Gauss's law in the case of static charge and steady current, respectively.

(d) An infinite solenoid (**N** turns per unit length, current **I**) is filled with linear material of susceptibility χ_m. Find the magnetic field inside the solenoid.

(e) A dielectric cube of side '*a*' centered at the origin carries a polarization $\vec{P}=k\vec{r}$ where **k** is a constant. Find the bound charges densities σ_b and ρ_b ?

(f) Why the nature of magnetic susceptibilities in paramagnet, diamagnet and ferromagnet are different?

2. (a) A uniformly charged disc of radius **R** having surface charge density c is placed in the **x-y** plane with its center at the origin. Find the electric field intensity along the **z**-axis at a distance **Z** from origin. (9)

(b) Verify that the differential version of Ampere's Law implies the integral version, using Stokes' Theorem. (6)

(c) Is the choice of the vector potential corresponding to a given magnetic field unique? Justify. (3)

3. (a) Obtain the boundary conditions for the electric field and displacement vector at the interface of two dielectric media having dielectric constants ε_1 and ε_2 respectively. (6)

(b) Which one of these is an impossible electrostatic field? Justify.

(i) $\vec{E}=k[xy\hat{i}+2yz\hat{j}+3xyz\hat{k}]$

(ii) $\vec{E}=k[y^2\hat{i}+(2xy+z^2)\hat{j}+2yz\hat{k}]$ (6)

(c) A solenoid of length 30 cm and area of cross-section 10 cm^2 has 1000 turns wound over a core of constant mu = 600. Another coil of 500 turns is wound over the same coil at its middle. Calculate the mutual inductance between them. (6)

4. (a) Calculate the divergence of electrostatic field due to a point charge **q** located at **r'** from the origin. Give the physical interpretation of your result. (9)

(b) A current distribution generates a vector potential $\vec{A}=xy\hat{i}+yz\hat{j}-4xyz\hat{k}$ Wb/m. Calculate the flux of magnetic field through the surface defined by z = 1, $0 \le x \le 1$ and $-1 \le y \le 4$ (6)

P.T.O.