COURSE :-

ELECTRO
MAGNETIC THEORY

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Question No 01 :- Part (B)

Ans :-

The radius of the circular coil $= 5 \times 10^{-2} m$

Number of turns of circular coil $= 40$

Current carried by circular coil $= 0.25A$

Magnetic feild is given as $B = \frac{\mu_o NI}{2a}$

$= \frac{4\pi \times 10^{-7} Tm/A (40) 0.25 A}{2.50 \times 10^{-2} m}$

$= \boxed{1.2 \times 10^{-4} T}$

Part No :- (A)

Ans The radius of Semiconductor piece of wire $= 0.20m$

Current Carried by Semiconductor piece of wire = 150 A

Magnetic feild is given as $B = \frac{\mu_0 N I}{2a}$

The differential form of Biot - stavart law is given by

$$dB = \frac{\mu_0 I}{4\pi} \frac{dI \sin\theta}{r^2} B$$

$$= 2.4 \times 10^{4} T$$

Q28-(a) Compute the magnetic field of a long straight wire that has a circular loop with a radius of 0.05m 2 amp is the reading of the current flowing through this closed loop.

Solution :-

Given

$R = 0.05m$

$I = 2 amp$

$\mu_0 = 4\pi \times 10^{-7} N/A^2$

Ampere's law formula is

$$\oint \vec{B} \, \vec{dl} = \mu_0 I$$

In case of long straight wire.

$$\oint \vec{dl} = 2\pi R = 2 \times 3.14 \times 0.05 = 0.314$$

$$B \oint \vec{dl} = \mu_0 I$$

$$\vec{B} = \frac{\mu_0 I}{2\pi R}$$

$$\vec{B} = \frac{4\pi \times 10^{-7} \times 2}{0.314} = 8 \times 10^{-6}\ T$$

Part B :-

Within the cylinder $\rho = 2, 0 < z < 1$, the potential is given by $V = 100 + 50\rho + 150\rho \sin\phi\ V$.

(a) Find V, E, D and ρ_v at P(1, 60°, 0.5) in free space.

First, substituting the given point, we find $V_P = 279.9\ V$.

then

$$E = -\nabla V = -\frac{\partial V}{\partial \rho} a_\rho - \frac{1}{\rho}\frac{\partial V}{\partial \phi} a_\phi = -[50 + 150\sin\phi]\, a_\rho$$

$$- [150 \cos\phi]\, a_\phi$$

Evaluate the above at P to find $E_P = -179.9 a_\rho - 75.0 a_\phi\ V/m$

$\rho_v = \nabla \cdot$

Now $D = \epsilon_0 E$, so $D_\rho = -1.59 a_\rho - 6.64 a_\phi \; nC/m^2$

$\rho_v = \nabla \cdot D = \left(\frac{1}{\rho}\right)\frac{d}{d\rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} = \left[\frac{-1}{\rho}(50 + 150\sin\phi) + \frac{1}{\rho} 150 \sin\phi\right]\epsilon_0 = \frac{50\,\epsilon_0 C}{\rho}$

At P this is $\rho_v P = -443 \, pC/m^3$.

(b) :- How much charge lies within the cylinder? We will integrate ρ_v over the volume to obtain.

$$Q = \int_0^1 \int_0^{2\pi} \int_0^{2} -\frac{50\epsilon_0}{\rho} \rho \, d\rho \, d\phi \, dz = -2\pi$$

QUESTION NO :- 03

we write :-

$$emf = \oint E \cdot dL = -\frac{d\Phi}{dt} = -\frac{d}{dt}\int\int_{Loop\ area} B \cdot a_z\, da = \frac{d}{dt}(0.3)(4)(6)\cos 5000 t$$

where the loop is chosen as positive a_z, so that path integral for E is taken around the positive a_ϕ direction. Taking the derivative we find

$$emf = -7.2(5000t) \text{ so that } I = \frac{emf}{R}$$

$$-\frac{36000 \sin 5000 t}{400 \times 10^3} = \boxed{-90 \sin 5000 t \text{ mA}}$$