Department of Electrical Engineering
Final Assignment
Date: 23-06-2020

Course Details

Course Title: Electro Magnetic Field Theory **Module:** 4th samester

Instructor: Dr.Rafiq Mansoor **Total Marks:** 50 .

Student Details

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Q1: Solve the following short Question	**(a)**	Determine the magnetic field at the center of the semicircular piece of wire with radius 0.20m. The current carried by the semicircular of wire is 150A.	**Marks 10** **CLO 2**
	(b)	A circular coil of radius 5×10^{-2} m and with 40 turns is carrying a current of 0.25 A. Determine the magnetic field of the circular coil at the center.	**Marks 10** **CLO 2**
Q2:	**(a)**	Compute the magnetic field of a long straight wire that has a circular loop with a radius of 0.05m. 2amp is the reading of the current flowing through this closed loop.	**Marks 07** **CLO 2**
	(b)	Within the cylinder ρ =2, 0< z <1, the potential is given by V = 100+50ρ+150ρ $Sin\phi$ V. (a) Find $V, E, D,$ and at p (1, , 0.5) in free space. (b) How much charge lies within the cylinder?	**Marks 08** **CLO 2**
Q3:	**(a)**	Given the time-varying magnetic field B= (0.5 +0.6 – 0.3) and a square filamentary loop with its corners at (2, 3, 0), (2,-3,0), and (-2,3,0) and (-2,-3,0), find the time-varying current flowing in the general direction if the total loop resistance is .	**Marks 15** **CLO 3**

Q 2
P(a)
Sol

radius of semicircular piece of wire = 0.20m
current carried by semicircular piece of wire = 150 A

Magnetic fields is given: $B = \frac{\mu_0 N I}{2a}$

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

$$B = \frac{\mu_0}{4\pi} I \int \frac{dl \times \hat{r}}{r^2}$$

$$= \frac{\mu_0}{4\pi} \frac{1}{r^2} \int dl$$

$$= \frac{\mu_0}{4\pi} \frac{I}{r^2} \pi r = \frac{\mu_0 I}{4r} =$$

$$= \frac{4\pi \times 10^{-7}\ T.m/A\ (150A)}{4(0.20m)}$$

$$= 2.4 \times 10^{-4}\ T \quad \text{Ans}$$

Q 1

part (b)

Sol

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

Number of turns of circular coil $= 40$

current carried by the circular coil $= 0.25A$

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

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

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

Ans

Q2
part (a)

Sol

Given data

$R = 0.05 m$

$I = 2 amp$

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

Ampere's law formula is

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

In the case of long straight wire

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

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

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

Ans

Q2

part (b)

Sol (a)

first 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.

$$E_P = -179.9\, a_\rho - 75.0\, a_\phi \quad V/m$$

Now $D = \epsilon_0 E$, so $D_P = -1.59\, a_\rho - .664\, a_\phi\ nC/m^2$.

Then $$\rho_v = \nabla \cdot D = \left(\frac{1}{\rho}\right)\frac{d}{d\rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi}$$

$$= \left[-\frac{1}{\rho}(50 + 150 \sin\phi\right]\epsilon_0 = -\frac{50}{\rho}\epsilon_0\ C$$

At P this is ρ_{vP}.

$$\rho_{vP} = -443\ pC/m^3.$$

(b) (5)

Now (b) How much lies int the cylinder ?

we will integrate ρ_v over the volume obtain

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

$$= -2\pi(50)\,\epsilon_0\,(2) = \boxed{-5.56\ nC}$$

(6)

Q3
(a)
sol

we write,

$$emf = \oint E \cdot dL$$

$$= \frac{d\Phi}{dt} = -\frac{d}{dt} \iint_{loop\ area}$$

$$B \cdot a_z \, da = \frac{d}{dt} (0.3)(4)(6) \cos 5000t$$

Where a loop is normal is chosen positive a_z, so that the path integral for E is taken around the positive a_ϕ direction.

Taking the derivative,

we find

$$emf = -7.2 (5000) \sin 5000t$$ so that

$$I = \frac{emf}{R} = \frac{-36000 \sin 5000t}{400 \times 10^3}$$

$$= -90 \sin 5000t \text{ mA}$$

Ans