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

Course Details

Course Title: Electro Magnetic Field Theory **Module:** ______

Instructor: ____________________ **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 *Sinϕ* 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**

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Q① Determine The magnetic field at the center of The Semicircular piece of wire The radius 0.20m The current carried by The Semicircular of wire is 150A.

Solution

Given Data.

The radius of The Semicircular piece of wire = 0.20m
Current carried by The Semicircular Piece " " = 150A
$\mu_0 = 4\pi \times 10^{-7}$ T.m

Solution

As we know that
Magnetic field is given as $B = \frac{\mu_0 N I}{2a}$
The differential from of Biot-Savart Law given as : $dB = \frac{\mu_0 I}{4\pi} \frac{dI \sin\theta}{r^2} B$

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

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

$$\frac{4\pi \times 10^{-7} \text{ T.m/A} (150 \text{ A})}{4(0.20\text{m})} = 2.4 \times 10^{-4} \text{ T}$$

Q(5) A circular coil of radius 5×10^{-2}m and with ~~Current Coil~~ 40 turns is carrying a current of 0.25A. Determine the magnetic field of the circular coil at the center.

Solution

Given Data:

The radius of the circular coil = 5×10^{-2}m

Number of turns of the circular coil = 40

Current carried by the circular coil = 0.25A

$\mu_0 = 4\pi\times10^{-7}$ T.m/A

Solution:

As we know that

Magnetic field is given

$$B = \frac{\mu_0 N I}{2a}$$

$$= \frac{4\pi\times10^{-7}\ T.m/A\ (40)(0.25)}{2\cdot 5.0\times10^{-2}m}$$

$$= 1.2\times10^{-4}\ T$$

Q2 (a) Computer 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 his Closed loop.

Solution

Given Data:

$R = 0.05m$

$I = 2amp$

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

Solution

As We know that

Ampere's law formula is

$$\oint \vec{B} d\vec{l} = \mu_0 I$$

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

$$B \oint d\vec{l} = \mu_0 I$$

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

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

Q2

(B)

Given Data:

$P = 2, 0 \angle Z \angle 1$

$V = 100 + 50\rho + 150\rho \sin \phi \, V$

Find

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

first Substituting the given point

We find $V_q = 279.9V$

$$E = -\nabla V = \frac{-\partial V}{\partial \rho} a_\rho - \frac{1}{\rho}\frac{\partial V}{\partial \phi} a_\phi$$

$$= -[50 + 150 \sin \phi] a_\rho - [150 \cos \phi] a_\phi$$

Evaluate the above at P to

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

Now

$D = \varepsilon_0 E$, So $D_P = -1.59 a_\rho - .664 a_\phi \, nC/m^2$

Then

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

$$= \left[-\frac{1}{\rho}(50 + 150 \sin \phi) + \frac{1}{\rho} 150 \sin \phi\right] \varepsilon_0 = \frac{-50}{\rho} \varepsilon_0 C$$

At P = This $\rho_{vP} = -443 pC/m^3$

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

$$Q = \int_1^1 \int_0^{2\pi} \int_0^2 -\frac{50\varepsilon_0}{\rho} \rho \, d\rho \, d\phi \, dz$$

$$= 2\pi(50)\varepsilon_0(2)$$

$$= -5.56 nC$$

(Q3)
(9)

Given Data

Magnetic field $B = (0.5a_x + 0.6a_y - 0.3a_z)\cos 500t$ T

Filamentary loop = (2,3,0) (2,-3,0) and (-2,-3,0)
Loop Resistance = 400k Ω

Find

a_ϕ

Solution

As we know that

$$emf = \oint E \cdot dL = -\frac{d\Phi}{dt} = -\frac{d}{dt}\iint_{loop\ area}$$

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

Where The loop normal is chosen as 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

$$I = \frac{emf}{R}$$

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

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