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

Course Detail

Course Title: Electro Magnetic Field Theory **Module:** 8th

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

Student Details

Name: Kiramat Ullah **Student ID:** 13290

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*ϕ 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**

Student Name: Kiramat Ullah
ID: 13290
Department: BE(E)
Semester: 8
Subject: Electromagnetic Field Theory
Teacher : Sir Dr Rafiq Mansoor

Question NO # 1 (Part A)

Solve the following short questions:

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 150 A.

Solution:-

The radius of the semicircular piece of wire = 0.2m

Current carried by semicircular piece of wire = 158 A

Magnetic field is given as

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

The difference between Biot-savart law is given by

Kiramatullah (2) ID NO #13290

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

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

$$= \frac{\mu_0}{4\pi} \frac{I}{r^2} \int d\vec{l}$$

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

$$= \frac{\mu_0 I}{4r}$$

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

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

Ans

QUESTION # 1

Part # B

Answers

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.

Solution:-

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

Number of turns of the circular coil $= 40$

Current carried by the circular coil $= 0.25$ A

Magnetic field ~~is~~ is given as:

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

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

Kiramatullah (4) ID NO # 13290

1.2×10^{-4} T Ans

X

QUESTION NO # 2

PART #(A)

Answer

Compute the magnetic field of a long straight wire that has a circular loop with a radius of 0.05m. 2am is the reading of the current flowing trough this closed loop.

Solution :-

Given that :-

Radius = R = 0.05m

I = 2amp

$\mu_0 = 4\pi \times 10^{-7}$ N/A²

Kisamatullah (5) ID No = 13290

Amperes Law formula is that:

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

In this case of long straigt wire.

$$\oint \vec{dI} = 2\pi R$$

$$= 2 \times 3.14 \times 0.05$$

$$\boxed{= 0.314}$$

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

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

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

$$\boxed{\vec{B} = 8 \times 10^{-6}\ T}$$ Ans,

Kiramatullah (6) ID NO# 13290

QUESTION NO # 2

Part #(B)

Answer

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.

b) How much charge lies within the cylinder.

Solution :-

A) $E = -\nabla V$

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

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

Evalute the above at P to find

$E_P = \underline{-179.9 a_\rho - 75.0 a_\rho \text{ V/m}}$

Now

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

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 $\rho_v P = \underline{-443\ pC/m^3}$. Ans

b) How mush charge lies within the cylinder.

Solution:-

Integrate that

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

$$= 2\pi\,(50)\,\epsilon_0\,(2)$$

$$\boxed{= -5.56\ nC}$$ Ans

QUESTION NO # 3

Part # (A)

Answer

a) Given the time - varying magnetic field $B = (0.5a_x + 0.6a_y - 0.3a_z)\cos 5000t$ T and a square filamentary loop with its corners at (2, 3, 0), (2, -3, 0), and (-2, 3, 0), find the time varying current flowing in the general a_ϕ direction total loop resistance is 400 kΩ.

Solution:-

Then,

$$EMF = \oint E \cdot dl = -\frac{d\phi}{dt} = -\frac{d}{dt}\iint_{\text{loop area}}$$

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

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

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

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

Anss

The END