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

Name: ______________ **Student ID:** ______________

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 ρ_v at p (1, 60°, 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= $(0.5a_x+0.6a_y-0.3a_z)\ cos5000t\ T$ 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 a_φ direction if the total loop resistance is $400k\Omega$.	**Marks 15** **CLO 3**

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Subject: EMF.

Q1

(a) Determine the magnetic field at the

....

.... semicircular of wire

is 150 A.

Given data.

Sol: radius of wire = 0.20m

Current carried wire = 150 A.

So Magnetic field is given

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

The different form of Biot-Savart law is given as

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

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

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

$$= \frac{\mu_0}{4\pi} \frac{1}{r^2} \pi r \,\circ$$

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

$$= \frac{4\pi \times 10^{-7}\ T\cdot m/A\,(150A)}{4\ (0.2m)}$$

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

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Q1

(b) A circular coil of radius 5×10^{-2} m

....

.... coil at center

Sol:- ~~Radius~~ Given data.

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

number of turns $= 40$

Current carried by coil = 0.25A

Sol. So,

We know that

Magnetic field is given as.

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

Putting the values in formula.

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

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

---- x ---- x ---- x ----

Q2

(a) Compute the magnetic field of a .... flowing through this closed loop.

Given data:

$R = 0.05 m$

$I = 2 amp$

we know

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

So, we have Amper's law formule

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

(in case of long straight wire)

$$\oint d\vec{l} = 2\pi R$$

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

$$= 0.314$$

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

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

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

$$= 8 \times 10^{-6}\ T$$

Ans.

— x — x — x — x —

Q2.

(b) Within the cylinder $\rho = 2, 0 < z < 1$

- - - - - - - - - - - - -

- - - - - - - - - - - - - - -

lies within the cylinder?

Sol. Given data.

$\rho = 2, 0 < z < 1.$

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

$V = ?$

$E = ?$

$D = ?$

$\rho_v = ?$

S1. First, substituting the given point we find.

$V_p = 279.9\,V.$ then.

~~E~~ =

Now E = ?

$E = -\nabla V$

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

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

Evaluate the above at P & find E_P

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

Now D = ?

$D = \varepsilon_0 E$

So,

~~$D_P = -1.59 a_\rho$~~

$D_P = -1.5 a_\rho - .664 a_\phi \ nC/m^2$

Now

$\rho_v = \nabla \cdot D$

$= (1/\rho) \, d/d\rho \, (\rho D_\rho)$

$+ \frac{1}{\rho} \frac{\partial D_\phi}{\partial \phi}$

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

$$\varepsilon_0 = -\frac{50}{p} \varepsilon_0 \, C.$$

At p. this is pvp.

$$\boxed{\rho_{vp} = -443 \, pC/m^3}$$

x —— x —— x —— x ——

Q3

(a) Given the time-varying magnetic field - - - - - - - - - - - - -

- - - - - - - - - - - - - - - - - - -

- - - - - - - - loop resistance is

400 kΩ.

Sol: Given data

$$B = (0.5a_x + 0.6a_y - 0.3a_z)$$

Square filametry loop with corner at (2,3,0).

(-2,-3,0)

resistance = $400k\Omega$.

Find time varying current is following in general a_ϕ.

So, we know that:

~~emf =~~

$$emf = \oint E \cdot dl$$

$$= -\frac{d\phi}{dt} = -d/dt \int$$

$$\int_{loop\,area} B \cdot a_z \, da$$

$$= d/dt \; (0.3)(4)(6) \cos 5000t.$$

Where the loop normal is chosen as positive a_z.

So that the path integral fo E is taken around the postive a_ϕ direction.

Taking the derivative, we get:

$$emf = -7.2 (5000) \sin 5000t.$$

So,

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

$$= \frac{-36000 \sin 500t}{400 \times 10^3}$$

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

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