CBCS SCHEME

USN | | | | | | | | | | **17EC36**

Third Semester B.E. Degree Examination, June/July 2023
Engineering Electromagnetics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. State and explain Coulomb's law of force between two point changes in vector form and mention the units. **(06 Marks)**

b. A 2mc positive charge is located in vaccum at $P_1(3, -2, -4)$m and 5μc negative charge is at $P_2(1, -4, 2)$m.
   i) Find the vector force on the negative charge
   ii) What is magnitude of force on the charge at P_1? **(08 Marks)**

c. Show that the electric field intensity at a point due to 'n' number of point charge is given by
$$\overline{E} = \frac{1}{4\pi \in_0} \sum_{\bar{z}=1}^{n} \frac{\theta_i}{R_1^2} \hat{a}_{R_i} \, V/m$$ **(06 Marks)**

OR

2 a. Derive an expression for the electric field intensity due to finite line charge. **(08 Marks)**

b. A ring of radius 6m is placed in yz plane it is centered at origin. Find the electric field intensity at point (8, 0, 0) the line charge density is 18nc/μ. Delivered formula has to be used. **(06 Marks)**

c. Define electric flux density. Explain Relationship between electric flux density and electric field intensity. **(06 Marks)**

Module-2

3 a. Prove that Gauss's law from Coulomb's law of point charge is placed in the origin of sphere. **(08 Marks)**

b. Find the charge in the volume defined by $0 \le x \le 1$, $0 \le y \le 1$ and $0 \le z \le 1$. If volume charge density is $\rho_v = 40x^2y$ μc/m³. **(06 Marks)**

c. Derive an expression for electric flux density of infinite line charge along Z axis in cylindrical surface. **(06 Marks)**

OR

4 a. Show that relationship between Electric field intensity and potential gradient $E = -\nabla V$. **(06 Marks)**

b. An electrostatic field is given by $\overline{E} = \left(\frac{x}{2} + 2y\right)\hat{a}_x + 2x\hat{a}_y V/m$. Find the work done in moving a point charge Q = 20μc from (4, 2, 0) to (0, 0, 0)m along a straight line path. **(08 Marks)**

c. Obtain the expression for point form of current continuity equation. **(06 Marks)**

Module-3

5 a. From point form of Gauss's law Derive an expression for Poisson's equation and Laplace's equation. **(06 Marks)**

b. State and prove uniqueness theorem. **(08 Marks)**

c. Verify that potential field given by below satisfies the Laplace's equation
   i) $V = 2x^2 - 3y^2 + z^2$ ii) $V = x^2 - y^2 + z^2$ **(06 Marks)**

OR

6 a. Using Biot – Savart law. Obtain an expression for magnetic field intensity due to infinite long straight conductors. **(08 Marks)**

b. State and prove Stoke's theorem. **(06 Marks)**

c. A differential current element with I = 4amp and $|d\overline{L}| = 10^{-3}$m is located at point (2, 0, 0) find the magnetic field intensity due to this current element at the point (0, 1, 1) **(06 Marks)**

Module-4

7 a. Obtain the expression for Lorentz force equation. **(06 Marks)**

b. A point charge of Q = -1.2c has velocity $\overline{V} = (5\hat{a}_x + 2\hat{a}_y - 2\hat{a}_z)m/s$. Find the magnitude of the force execrated on the charge. If

i) $\overline{E} = -18\hat{a}_x + 5\hat{a}_y - 10\hat{a}_z)V/m$

ii) $\overline{B} = -4\hat{a}_x + 4\hat{a}_y + 3\hat{a}_z)$

iii) Both are present simultaneously **(08 Marks)**

c. Derive an expression for the force between differential current elements. **(06 Marks)**

OR

8 a. Discuss the magnetic boundary conditions as applicable to $\overline{B}$ and $\overline{H}$ at the interface between two different magnitude magnetic materials. **(10 Marks)**

b. Write a short note on forces on magnetic materials. **(05 Marks)**

c. Derive an expression for inductance of a coaxial cable. **(05 Marks)**

Module-5

9 a. Starting from Faraday's law of electromagnetic indirection, Derive an expression

$$\nabla \times \overline{E} = -\frac{\partial \overline{B}}{\partial t}$$ **(06 Marks)**

b. Derive the expression for displacement current density using Ampere's circuital law. **(08 Marks)**

c. A circular conducting loop of radius 40cm lies in xy plane and has resistance of 20n. If the magnetic flux density in the region is given as

$\overline{B} = 0.2\text{Cos } 500t\ \hat{a}_x + 0.75 \sin 400t\ \hat{a}_y + 12 \text{ Cos } 314t\ \hat{a}_z$ T

Determine effective value of induced current in the loop. **(06 Marks)**

OR

10 a. List the Maxwell's equation in integral form and point form and derive the point form of Maxwell's equation for time varying fields. **(10 Marks)**

b. State and prove Poynting theorem and show that the average power density (P_{avge}) **(10 Marks)**

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