CBCS SCHEME

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18EE45

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Electromagnetic Field Theory

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Given : $\vec{A} = 2\hat{a}_x - \hat{a}_y + 3\hat{a}_z$ and $\vec{B} = -5\hat{a}_x - 6\hat{a}_y + 7\hat{a}_z$. Find $\overline{A} \times \overline{B}$ set's magnitude. **(06 Marks)**

b. Derive relation between cylindrical and rectangular coordinate system. **(06 Marks)**

c. State and prove coulomb's law in vector form. **(08 Marks)**

OR

2 a. Derive expression for electric field intensity due to several charges. **(07 Marks)**

b. Calculate field intensity at point P(1, 2, 3) due to charge of 10nc at A(2, 3, 4). **(07 Marks)**

c. State and prove Gauss law. **(06 Marks)**

Module-2

3 a. State that $E = -\nabla \cdot V$. **(07 Marks)**

b. Given field intensity $E = 40xy\hat{a}_x + 20x^2\hat{a}_y + 2\hat{a}_z$, calculate the potential difference between two points P(1, –1, 0) and Q(2, 1, 3). **(07 Marks)**

c. Derive expression for potential due to several point charges. **(06 Marks)**

OR

4 a. Derive an expression for continuity of current equation. **(10 Marks)**

b. Find $\vec{E}$ and $\vec{J}$ considering the drift velocity of 60×10^{-4}m/s in the case of silver conductor using the data $\sigma_{silv} = 61.7 \times 10^6$s/m and $\mu_{sil} = 5.6 \times 10^{-3}$m^2/vs. **(10 Marks)**

Module-3

5 a. Given $V = (Ar^4 + Br^{-4}) \sin 4\phi$, show that $\nabla^2 V = 0$. **(07 Marks)**

b. Derive uniqueness theorem. **(09 Marks)**

c. Verify the potential field $V = 2x^2 - 3y^2 + z^2$ satisfies the Laplace equation. **(04 Marks)**

OR

6 a. State and prove Amper's circuital law. **(07 Marks)**

b. Given vector magnetic $\vec{A} = x^2\hat{a}_x - 2yz\hat{a}_y + (-x^2)\hat{a}_z$. Find magnetic flux density. **(07 Marks)**

c. Calculate the value of vector circuit density at P(2, 3, 4) if $\vec{H} = x^2z\hat{a}_y - y^2x\hat{a}_z$. **(06 Marks)**

Module-4

7 a. Derive expression for the force between two parallel current carrying conductors. **(07 Marks)**

b. Find torque on a square loop having at corner (–2, –2, 0), (2, –2, 0), (2, 2, 0) and (–2, 2, 0).

i) About origin by $B = 0.4\hat{a}_x$

ii) About origin by $B = 0.6\hat{a}_x - 0.4\hat{a}_y$

iii) About origin by $B = 0.4\hat{a}_x + 0.6\hat{a}_y - 0.7\hat{a}_z$ take $I = 0.8A$. **(08 Marks)**

c. If a point of 2C moves with a velocity of $(6\hat{a}_x + 3\hat{a}_y - 5\hat{a}_z) m/s$. Find force exerted :

i) If electric field intensity is $(10\hat{u}_x + 8\hat{u}_y - 5\hat{u}_z)$

ii) If flux density is $(5\hat{u}_x + 4\hat{u}_y + 6\hat{u}_z) wb/m^2$. **(05 Marks)**

OR

8 a. Magnetic flux density is given as 1.2T when H = 300A/m when H is increased to 1500A/m. The B is increased to 1.5T what is the parentage change in the magnetization vector. **(07 Marks)**

b. Derive an expression for inductance of a solenoid. **(06 Marks)**

c. Derive an expression for energy stored in a magnetic field. **(07 Marks)**

Module-5

9 a. List Maxwell's equations in differential form and integral form. **(08 Marks)**

b. Derive expression for uniform plane wave propagating in free space. **(12 Marks)**

OR

10 a. Derive expression for pointing vector. **(10 Marks)**

b. Explain and derive expression for skin depth. **(10 Marks)**

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