CBCS SCHEME

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15EC36

Thrid Semester B.E. Degree Examination, Jan./Feb. 2023
Engineering Electromagnetic

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State and explain Coulomb's law for Electrostatic force. **(05 Marks)**

b. A point charge of 0.1nc is located at (0, 0.1, 0)m another charge of 0.1nc is located at $(0, -0.1, 0)$. Find $\bar{E}$ at P (0.2, 0, 0)m. **(05 Marks)**

c. Define Electric field intensity and flux density. Also obtain relation between $\bar{E}$ and $\bar{D}$. **(06 Marks)**

OR

2 a. A uniform line charge of i_L = 25nc/m lies on the line x = −3m and y = 4m in free space. Find $\bar{E}$ at P(2, 3, 15)m. **(05 Marks)**

b. Derive expression for electric field intensity due to infinite line charge. **(08 Marks)**

c. Find the total charge inside a volume charge density as $10z^2 e^{-0.1x} \text{Sin } \pi y/cm^3$. The volume is defined between $-2 \le x \le +2$, $0 \le y \le 1$, and $3 \le z \le 4$. **(03 Marks)**

Module-2

3 a. State and prove Gauss's law. **(06 Marks)**

b. Given that $\bar{D} = 5\text{Sin } \theta \hat{a}_\theta + 5\text{Sin } \phi \hat{a}_\phi$ find volume charge density at $\left(0.5m, \frac{\pi}{4}, \frac{\pi}{4}\right)$ in spherical Coordinate system. **(06 Marks)**

c. Define vector operator Del "∇". **(04 Marks)**

OR

4 a. Obtain relation between $\vec{E}$ and V. **(04 Marks)**

b. Find the potential at r_A = 5m r_B = 15m due to a point charge Q = 500pc placed at the origin, find the potential at r_A = 5m, assuming zero as potential at Infinity. Also obtain potential difference between point A and B. **(06 Marks)**

c. state and prove Gauss's divergence theorem. **(06 Marks)**

Module-3

5 a. Verify the potential field below satisfies Laplace equation or not
$V = 2x^2 - 3y^2 + z^2$ **(04 Marks)**

b. Write note on uniqueness theorem and derive the same. **(07 Marks)**

c. Derive Laplace and Poisson's equations. **(05 Marks)**

OR

6 a. State and prove Ampere's circuital law. **(06 Marks)**

b. If magnetic filed intensity in a region is $\overline{H} = (3y-2)\hat{a}_z + 2x\,\hat{a}_y$ find current density at origin. **(04 Marks)**

c. Write note on magnetic scalar and vector potentials. **(06 Marks)**

Module-4

7 a. Explain and derive force between differential current elements. **(08 Marks)**

b. A point charge Q = 18nc has a velocity of 5×10^6 m/s in the direction $\bar{a}_v = 0.6\hat{a}_x + 0.75\hat{a}_y + 0.3\hat{a}_z$. Calculate the magnitude of the force exerted on charge by the field.

i) $\overline{E} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z Kv/m$

ii) $\overline{B} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z mT$

iii) $\overline{B}$ and $\overline{E}$ acting together. **(08 Marks)**

OR

8 a. Write note on magnetic circuits. **(06 Marks)**

b. If $\overline{B} = 0.05 \times \hat{a}_y$ T in a material for which $X_m = 2.5$. Find

i) μ_r ii) μ iii) $\overline{M}$ iv) $\overline{J}$ **(04 Marks)**

c. Discuss the boundary conditions at the interface between 2 different magnetic materials. **(06 Marks)**

Module-5

9 a. List Maxwell's equations in point form and Integral form for time varying fields. **(08 Marks)**

b. For a lossy dielectric σ = 5s/m and $\epsilon_r = 1$. The electric field intensity is $\overline{E} = 100$ Sin 10^{10} t. find J_c, J_d and frequency at which both have equal magnitudes. **(08 Marks)**

OR

10 a. Starting from Maxell's equation derive the wave equation for a uniform plane wave travelling in free space. **(07 Marks)**

b. State and prove poynting theorem. **(06 Marks)**

c. Wet Marshy soil is characterized by $\sigma = 10^{-2}$ s/m, $\epsilon_r = 15$ and $\mu_r = 1$. At the frequencies 60Hz, 1MHz, 100MHz indicate whether soil may be considered a conducting dielectric or neither. **(03 Marks)**

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