CBCS SCHEME

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15EC36

Third Semester B.E. Degree Examination, July/August 2021
Engineering Electromagnetics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

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

b. Three equal charges of 1 μC each are located at the three corners of a square of 10 cm side. Find the electric field intensity at the forth vaccent point of the square. **(10 Marks)**

2 a. A line charge $\rho_L = 50\,nC/m$ is located along the line x = 2, y = 5 in free space. Find $\vec{E}$ at P(1, 3, -4). **(06 Marks)**

b. Derive the expression of electric field intensity due to infinite line charge. **(10 Marks)**

3 a. State and prove the Gauss's law. **(10 Marks)**

b. Given the flux density $\vec{D} = \frac{5\sin\theta.\cos\phi}{r}\hat{a}_r\ C/m^2$. Find (i) Volume charge density

(ii) Total flux leaving the surface of spherical volume of radius 2 m. **(06 Marks)**

4 a. State and derive the expression of law of continuity of current. **(07 Marks)**

b. An electric potential is given by,

$V = \frac{60\sin\theta}{r^2}$ volt. Find V and E at point P(3, 60°, 25°). **(06 Marks)**

c. Express $\vec{\nabla}.\vec{D}$ in three coordinate systems. **(03 Marks)**

5 a. Starting from Gauss's law in integral form, derive Laplace's and Poisson's equations. Write the Laplace equation in all the coordinate systems. **(06 Marks)**

b. Determine whether or not the following vectors represent a possible electric field:

$\vec{E} = (12yx^2 - 6z^2x)\hat{a}_x + (4x^3 + 18zy^2)\hat{a}_y + (6y^3 - 6zx^2)\hat{a}_z$ **(03 Marks)**

c. State and prove uniqueness theorem. **(07 Marks)**

6 a. State Biot-Savart law. Obtain an expression for magnetic field intensity for current element. **(08 Marks)**

b. Explain the concept of scalar and vector magnetic potential and show that

$\vec{A} = \frac{\mu_0}{4\pi}\int\frac{\vec{J}}{r}dV$. where $\vec{A}$ = Vector magnetic potential and J = current density **(08 Marks)**

7 a. Write short notes on force between two differential current elements. **(08 Marks)**

b. A point charge $\theta = -60\,nC$, is moving with a velocity 6×10^6 m/s in the direction specified by unit vector $(-0.48\hat{a}_x - 0.6\hat{a}_y + 0.64\hat{a}_z)$. Find the magnitude of the force on a moving charge in the magnetic field

$\vec{B} = (2\hat{a}_x - 6\hat{a}_y + 5\hat{a}_z)mT$. **(08 Marks)**

8 a. Derive the expression for the boundary condition for the tangential component at the interface between two media with different permeabilities. (06 Marks)

b. If $\vec{B} = 0.5x\hat{a}_y T$ in a material for which $\chi_m = 2.5$ find,

(i) μ_r (ii) μ (iii) $\vec{H}$ (iv) $\vec{M}$ (v) $\vec{J}$. (10 Marks)

9 a. Write Maxwell equations in points form and integral form. (06 Marks)

b. State and prove Faraday's law. (05 Marks)

c. Given $\vec{H} = H_m e^{j(\omega t+\beta z)}\hat{a}_x$ A/m in free space. Find $\vec{E}$. (05 Marks)

10 a. Derive the expression for Poynting's theorem. (10 Marks)

b. Write the short notes on skin effect. (06 Marks)

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