Electromagnetic Fields Big Questions (both Problems and Derivative Questions) are prepared from Anna University Question Papers

Questions are arranged and soft copy prepared by

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UNIT-I STATIC ELECTRIC FIELDS

General

1. **If two vectors are expressed in Cartesian coordinates as**

$$\mathbf{A} = 2\mathbf{a}_x + \pi\mathbf{a}_y + \mathbf{a}_z$$

$$\mathbf{B} = -\mathbf{a}_x + \frac{3\pi}{2}\mathbf{a}_y - 2\mathbf{a}_z$$

Compute a unit vector perpendicular to the plane containing A and B.

2. **Use spherical co-ordinates and integrate to find the area of the region $0 \le \Phi \le \alpha$ on the spherical shell of radius 'a'. What is the area of $\alpha = 2\pi$?**

3. **Let $\overline{A} = 5\overline{a_x}$ and $\overline{B} = 4\overline{a_x} + B_y\overline{a_y}$ .Find by such that, angle between $\overline{A}$ and $\overline{B}$ is 45^0. If $\overline{B}$ also has a term $B_z\overline{a_z}$, what relationship must exist between by B_y and B_z.**

4. **Two small diameter 10gm dielectric balls can slide freely on a vertical channel. Each carries a negative charge of 1micro coulomb. Find the separation between the balls if the lower ball is restrained from the moving.**

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Force

5. **A regular tetrahedron has vertices at P1(2,0,0), P2(-1,√3,0), P3(-1,-√3,0) and P4(0,0,2√2). Charges of 1mC are located at each of the four vertices. If the configuration is located in free space, find the magnitude of force on each charge.**

6. **Two small identical conducting spheres have charges of 2nC and -1nC respectively. When they are separated by 4 cm apart, find the magnitude of the force between them. If they are brought into contact and then again separated by 4cm, find the force between them.**

7. **A positive charge Q_v c/m^3 occupies the volume of a sphere. At a point in the interior at a distance of 'r' from the centre, a small probe of charge of +q is inserted. What is the force acting on the probe charge?**

Electric Field Intensity

8. **Consider two point charges $Q_1 = 8\pi\varepsilon_o$ coulombs and $Q_2 = -4\pi\varepsilon_o$ coulombs situated at (-1,0,0) and (1,0,0)m respectively. Find the electric field intensity at the point (0,0,1). Draw the phasor diagram.**

9. **The potential distribution in an electric field is given by $V = 8x + 6y^2 - 3z^{\frac{1}{2}}$**

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volts. Determine the expression for electric field 'E'. Find its magnitude and direction at (2,1,2)m.

10. Determine the electric field intensity at P(-0.2,0,-2.3) due to a point charge of +5 nC at Q(0.2,0.1,-2.5) in air. All dimensions are in meters.

11. If $V = \frac{60\sin\theta}{r^2}$ volts, find V and E at P(3,60°,25°) where V=electric potential and E=electric field intensity.

12. A uniform line charge $\rho_L = 25nC/m$ lies on the line, x= -3m and y =4 m in free space. Find the electric field intensity at a point (2,3,15)m.

13. Show that Electric field due to 'n' number of charges

$$\vec{E} = \frac{1}{4\pi\varepsilon}\sum_{i=1}^{n}\frac{Q_i}{|r_i|^2}a_i$$

Potential (or) Potential Difference

14. A uniform line charge of 1n/C is situated along x-axis between the points (-500,0) and (500, 0)mm. Find the electric scalar potential at(0,1000)mm.

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15. Given field intensity, $\mathbf{E = 40\,xyu_x + 20\,x^2u_y + 2u_z}$ calculate the potential difference between two points P(1,-1,0) and Q(2,1,3).

Electric Flux Density

16. Three charged cylindrical sheets are present in three spaces with $\sigma = 5C/m^2$ at R = 2m, $\sigma = -2C/m^2$ at R = 4m, and $\sigma = -3C/m^2$ at R = 5m. Find flux density at R = 1,3,4,5 and 6m.

Divergence Theorem

17. A particular vector field $F = r^2\cos^2\phi a_r + z\sin\phi a_\phi$ is a cylindrical system. Find the flux emanating due to the field from the closed surface of the cylinder $0 \le Z \le 1$, r = 4. Verify divergence theorem.

18. Given that $D = \frac{5r^2}{4}a_r C/m^2$. Evaluate both the sides of divergence theorem for the surface enclosed by r = 4 cm and $\theta = \Pi / 4$.

19. A vector field $D = \frac{5r^2}{4}a_r C/m^2$ is given in spherical coordinates. Evaluate both sides of divergence theorem for the volume enclosed between r = 1 and r = 2cm.

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Stokes Theorem

20. Consider a portion of the sphere surface is specified by $r = 4, 0 \le \theta \le 0.1\pi, \quad 0 \le \phi \le 0.3\pi$ **and a closed path forming a perimeter composed of three circumference arcs. The field** $H = 6r\sin\phi a_r + 18r\sin\theta\cos\phi a_\phi$ **. Evaluate each side of Stoke's theorem.**

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