(1)

15EC207 - Electromagnetics & Transmission Lines

Unit - I

1) A vector A is represented by components (A_x, A_y, A_z), (A_r, A_ϕ, A_z) and (A_r, A_θ, A_ϕ) in three co-ordinate systems. If $A_x = A_y = A_z = 1$ and $\theta = \phi = 4$ the radial component of the vector A in spherical co-ordinate and cylindrical co-ordinates are related as

a) less than cylindrical
b) greater than cylindrical
c) equal to cylindrical
d) not related to cylindrical

2) The vector transformation between cylindrical and spherical co-ordinates is given as,

a) $$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\theta & 0 & \cos\theta \\ \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$$

b) $$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \\ \cos\theta & -\sin\theta & 0 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$$

c) $$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \\ \cos\phi & -\sin\phi & 0 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$$

d) $$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\phi & 0 & \cos\phi \\ \cos\phi & 0 & -\sin\phi \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$$

3) The vectors $C = (3\vec{a_r} + \vec{a_\phi} + \sqrt{2}\,\vec{a_z})$ and $D = 6\sqrt{2}\,\vec{a_r} + 4\sqrt{2}\,a$

are.

a) parallel

b) perpendicular

c) at an angle 42°

d) unrelated.

4) The force F_1, on the charge Q_1 due to second charge Q_2 is given by,

a) $F_1 = \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 R_{21}^3}\,\vec{a_{21}}$

b) $F_1 = \dfrac{Q_1 Q_2}{4\pi\varepsilon_0 R_{21}^3}\cdot\vec{R_{21}}$

c) $F_1 = \dfrac{Q_1 Q_2}{2\pi\varepsilon_0 R_{21}^3}\,\vec{a_{21}}$

d) $F_1 = \dfrac{Q_1 Q_2}{2\pi\varepsilon_0 R_{21}^3}\cdot\vec{R_{21}}$.

5) The electric field intensity, $\vec{E} = -\text{grad}(V)$ along the direction of a_ϕ in spherical co-ordinates is given by,

a) $E_\phi = \dfrac{2p}{2\pi\varepsilon_0 r^3}\sin\theta$

b) $E_\phi = \dfrac{2p}{4\pi\varepsilon_0 r^3}\cos\theta$

c) $E_\phi = 0$

d) $E_\phi = 1$

6) The electric field intensity, E between two infinite sheets of charge with density ρ_s located at $x = \pm 1$ respectively is

a) $\vec{E} = \frac{1}{2\varepsilon_0} \vec{a_n}$

b) $\vec{E} = \frac{-1}{2\varepsilon_0} \vec{a_n}$

c) $\vec{E} = 0$

d) $\vec{E} = -\frac{\rho_s}{\varepsilon_0} \cdot \vec{a_x}$

7) The Gauss's law for electrostatics can be mathematically represented as

a) $\vec{D} \cdot d\vec{s} = Q_{enc}$

b) $\int \psi \cdot d\vec{s} = Q_{enc}$

c) $\psi = Q_{enc}$

d) $\vec{D} = Q_{enc}$

8) The electric field E is ________ to the electric equipotential lines

a) normal c) opposite

b) tangential d) unrelated

9) The electric flux density D is ________ to the electric flux lines

a) normal c) opposite

b) tangential d) unrelated

10) When a potential difference is applied ... human heart, its behaviour can be modeled as that of electric dipole. Abnormal hearts can be detected by mapping:

a) equipotential surfaces
b) electric flux lines
c) electric fields
d) all of the above

11) A Gaussian surface within a metallic spherical shell of inner and outer radii R_1 and R_2 contains charge Q placed at the center. The normal component of D at the Gaussian surface will be

a) zero b) $\frac{Q}{4\pi R_1^2}$ c) $\frac{Q}{4\pi R_2^2}$ d) $\frac{Q}{4\pi (R_1-R_2)^2}$

12) Two concentric hollow spheres of radii R_1 and R_2 ($R_1 > R_2$) have respective charges Q_1 & Q_2 distributed uniformly over their surfaces. The electric flux density $\vec{D}$ at a Gaussian surface of radius 'r' such that ($R_1 > r > R_2$) will be

a) $\frac{Q_1}{4\pi R_1^2}$ b) $\frac{Q_1}{4\pi r^2}$ c) $\frac{Q_2}{4\pi R_2^2}$ d) $\frac{Q_2}{4\pi r^2}$

13) Usually a collection of positive charges is considered for constructing a Gaussian surface. If a Gaussian surface encloses a collection of negative charges, then for such a surface

a) the normal component of D will become zero

b) the normal component of D will point inwards

c) the normal component of D will point outwards

d) the normal component of D will become infinity

14) The divergence of a vector in spherical co-ordinates is given by,

$$\nabla \cdot \vec{A} = \frac{1}{r^2}\frac{\partial(r^2 A_r)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial}{\partial\theta}(A_\theta \sin\theta) + \frac{1}{r\sin\theta}\cdot\frac{\partial A_\phi}{\partial\phi}$$

The operator ∇ is given by,

a) $\frac{1}{r^2}\frac{\partial(r^2)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial(\sin\theta)}{\partial\theta} + \frac{1}{r\sin\theta}\frac{\partial}{\partial\phi}$

b) $\frac{1}{r^2}\frac{\partial(r^2)}{\partial r}\vec{a_r} + \frac{1}{r\sin\theta}\cdot\frac{\partial(\sin\theta)}{\partial\theta}\cdot\vec{a_\theta} + \frac{1}{r\sin\theta}\cdot\frac{\partial}{\partial\phi}\vec{a_\phi}$

c) $\frac{\partial}{\partial r} + \frac{1}{r}\frac{\partial}{\partial\theta} + \frac{1}{r\sin\theta}\cdot\frac{\partial}{\partial\phi}$.

d) $\frac{\partial}{\partial r}\vec{a_r} + \frac{1}{r}\frac{\partial}{\partial\theta}\vec{a_\theta} + \frac{1}{r\sin\theta}\cdot\frac{\partial}{\partial\phi}\cdot\vec{a_\phi}$

15) The potential gradient in cylindrical co-ordinate system is given by,

a) $\frac{\partial V}{\partial r} + \frac{\partial V}{r \partial \phi} + \frac{\partial V}{\partial z}$.

b) $\frac{\partial V}{\partial r}\vec{a_r} + \frac{\partial V}{r \partial \phi}\vec{a_\phi} + \frac{\partial V}{\partial z}\vec{a_z}$

c) $\frac{1}{r}\frac{\partial V}{\partial r}\vec{a_r} + \frac{1}{r}\frac{\partial V}{\partial \phi}\cdot\vec{a_\phi} + \frac{1}{r}\frac{\partial V}{\partial z}\cdot\vec{a_z}$

d) $\frac{1}{r d\phi}\cdot\frac{\partial V}{\partial r}\vec{a_r} + \frac{1}{r}\frac{\partial V}{\partial \phi}\cdot\vec{a_\phi} + \frac{1}{r d\phi}\frac{\partial V}{\partial z}\cdot\vec{a_z}$

16) The relationship between electric field intensity, E and potential V is given by,

a) $\vec{E} = -\nabla V$

b) $V = -\nabla.\vec{E}$

c) $V = -\nabla \times \vec{E}$

d) $\vec{E} = \nabla V$

17) In an electric circuit, the energy store in the field of a capacitor is given by,

a) $W_E = \frac{1}{2}CV^3$

b) $W_E = \frac{1}{2}CV^2$

c) $W_E = \frac{1}{4}CV^2$

d) $W_E = \frac{1}{3}CV^2$

18) The potential V due to a point charge is given by,

a) $V = \dfrac{Q_1 Q_2}{4\pi \varepsilon_0 r^2}$

b) $V = \dfrac{Q_1 Q_2}{2\pi \varepsilon_0 r^2}$

c) $V = \dfrac{Q}{4\pi \varepsilon_0 r}$

d) $V = \dfrac{Q_1 Q_2}{2\pi \varepsilon_0 r}$

19) The relation between the electric flux density $\vec{D}$ and Electric field intensity, $\vec{E}$ is given by,

a) $\vec{E} = \varepsilon \vec{D}$

b) $\vec{E} = \dfrac{\vec{D}}{\varepsilon}$

c) $\vec{E} = \dfrac{\vec{D}}{\rho \varepsilon}$

d) $\vec{E} = \dfrac{\rho \vec{D}}{\varepsilon}$

20) The dielectric dipole moment 'p', of charge Q and distance 'd' is given by,

a) $p = Qd$

b) $d = Qp$

c) $Q = p \cdot d$

d) $Q = p \cdot d^2$