



- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions
 (10 X 10 = 100 Marks)

1. Transform the following vector into spherical coordinates

$$Q = \frac{\sqrt{x^2 + y^2}}{\sqrt{x^2 + z^2 + y^2}} \hat{a}_x - \frac{yz}{\sqrt{x^2 + z^2 + y^2}} \hat{a}_z$$

[10]

2. i) Determine the curl of

$$A = x^2 y z \hat{a}_x + x z \hat{a}_z$$

$$B = \rho \sin \phi \hat{a}_\rho + \rho^2 z \hat{a}_\phi + z \cos \phi \hat{a}_z$$

- ii) Determine the divergence of

$$C = \frac{1}{r^2} \cos \theta \hat{a}_r + r \sin \theta \cos \phi \hat{a}_\theta + \cos \theta \hat{a}_\phi$$

[3+3+4]

3. Point charges 1 mC and -2 mC are located at (3,2,-1) and (-1,-1,4), respectively. Calculate the electric force on a 10 nC charge located at (0,3,1) and the electric field intensity at that point.

[10]

4. The electric flux density in free space is given by

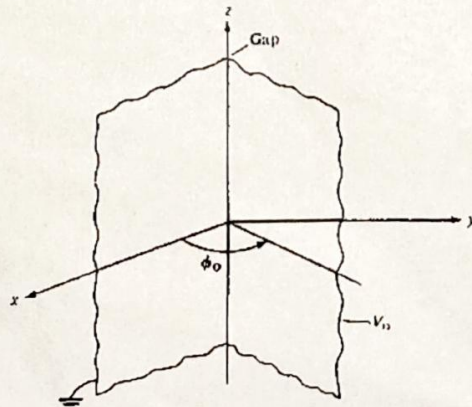
$$D = y^2 \hat{a}_x + 2xy \hat{a}_y - 4z \hat{a}_z \text{ nC/m}^2$$

(a) Find the volume charge density
 (b) Determine the flux through surface $x=3$, $0 < y < 6$, $0 < z < 5$.

[10]

5. Semi-infinite conducting planes at $\Phi=0$ and $\Phi=\pi/6$ are separated by an infinitesimal insulating gap as shown in Fig. If $V=0$ at $\Phi=0$ and $V=100\text{V}$ at $\Phi=\pi/6$, calculate V and E in the region between the plates.

[10]



6. A coaxial cable has an internal inductance that is twice the external inductance. If the inner radius is 6.5 mm, calculate the outer radius. Also, calculate the internal inductance of the same conductor. Consider it is 6 cm long. [10]
7. In medium 1 ($z < 0$) $\mu_1 = 5\mu_0$ while in medium 2 ($z > 0$) $\mu_2 = 2\mu_0$. If $B_1 = 4\hat{a}_x - 10\hat{a}_y + 12\hat{a}_z$ mWb/m², find B_2 and energy density in medium 1 and medium 2. [10]
8. Draw the characteristics of electromagnetic interference (EMI) and explain its sources and causes. [10]
- 9.a) In free space $E = 20 \cos(\omega t - 50x)\hat{a}_y$ V/m, calculate J_c , J_D and H . [10]
- OR
- 9.b) A medium is characterized by $\sigma = 0$, $\mu = 2\mu_0$ and $\epsilon = 5\epsilon_0$. If $H = 2 \cos(\omega t - 3y)\hat{a}_z$ A/m, calculate ω and E . [10]
- 10.a) The plane wave in a nonmagnetic medium has $E = 50 \sin(10^8 t + 2z)\hat{a}_y$ V/m. Find (i) The direction of the wave propagation. (ii) λ , f and ϵ_r (iii) H [10]
- OR
- 10.b) In a nonmagnetic medium $E = 4 \sin(2\pi \times 10^7 t - 0.8x)\hat{a}_z$ V/m Find (i) η , ϵ_r (ii) The time average power carried by the wave (iii) The total power crossing 100 cm² of plane $2x + y = 5$. [10]

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