(37)

T2925 / T0481 ELECTROMAGNETIC FIELDS & WAVES

Dec-17
EFW

Q.P. Code : 22954

[Time: 3 Hours] **[Marks: 80]**

Please check whether you have got the right question paper.

N.B: 1. Questions no. 1 is compulsory.
2. Attempt any three questions from remaining five questions.

1. (a) If, $\nabla \times V = 0$ find constants a,b and c so that $V=(x + 2y + az)\,\bar{a}_x + (bx - 3y - z)\,\bar{a}_y + (4x + cy + 2z)\,\bar{a}_z$ is irrotational. **5**

(b) Explain the relation $E = -\nabla V$.

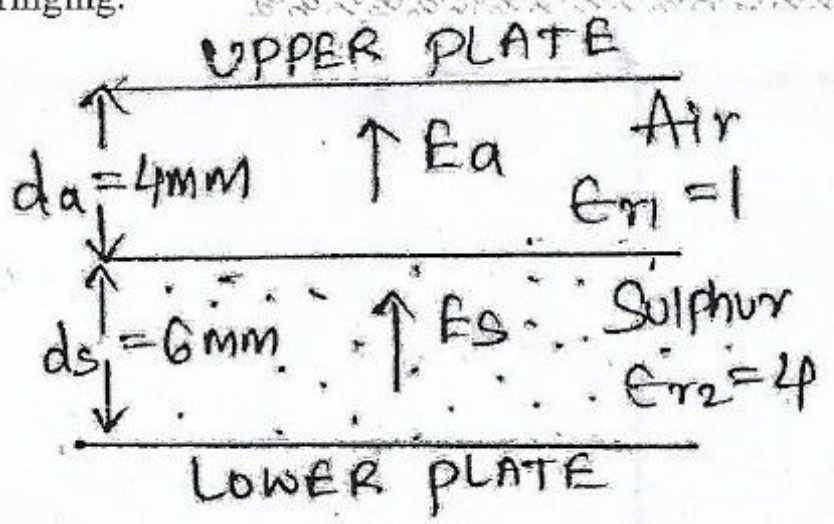
(c) State and explain coulomb's law in electrostatics. Hence define unit charge. **5**

(d) Write down the Maxwell's equation for different material media. **5**

2. (a) Given points A (1, 2, 4) B(-2, -1, 3) and C (3, 1, -2) let a differential current element with I = 6 A and $|dL| = 10^{-4}$ m be located at A. The direction of dL is from A to B find dH at C.| **10**

(b) Prove that the electric flux passing through any closed surface is equal to the total charge enclosed by that surface. **10**

3. (a) Find the total capacitance (see fig.1) if plates are square with 500 mm side. Neglect fringing. **10**



(b) Show that $\nabla \times \bar{E} = \frac{-\partial B}{\partial t}$ If $\bar{E} = 200e^{(3x-kt)}\,\bar{a}_y (v/m)$ in free space, use maxwells equation to find $\bar{H}$ knowing that all fields vary with time as e^{-kt}. **10**

4. (a) Evaluate both the sides of the divergence theorem for the field $\bar{D} = 2xy\,\bar{a}_x + x^2\bar{a}_y (C/m^2)$ and the rectangular parallel piped formed by the planes X = 0 and X = 1, Y = 0 and Y = 2 and Z = 0 and Z = 3. **10**

(b) Starting from Maxwell equation obtain wave equation for the field $\bar{E}$ and $\bar{H}$ for free space. **10**

5\. (a) A charge of 10 nc is moving with a velocity of $10^7(-0.5\bar{a}_x + \bar{a}_y - 0.71\bar{a}_z)$ m/s determine the force exerted on the test charge when: **10**

i) A magnetic Induction $\bar{B} = (\bar{a}_x + 2\bar{a}_y + 3\bar{a}_z)\, mwb/m^2$ is applied.

ii) An electric field $\bar{E} = (3\bar{a}_x + 2\bar{a}_y + \bar{a}_z)\, Kv/m$ is applied.

iii) When $\bar{B}$ and $\bar{E}$ given above are applied simulanteously.

(b) Derive the expression for electric field due to infinite sheet charge.

6\. (a) A dielectric – free space interface has the equation 3x + 2y + z = 12m The origin side of the interface has $\epsilon_{r1} = 3$ *and* $\bar{E}_1 = 2\bar{a}_x + 5\bar{a}_z\,(v/m)$ find $\bar{E}_2$ **10**

(b) A charge Q located at the origin in free space produces a field for which E_z = 1k v/m at a point P(-2, 1, -1) find Q. Also find $\bar{E}$ at M (1, 6, 5) in Cartesian co-ordinates. **10**
