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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; June - 2016

Electromagnetic and Antennas

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer any **FIVE** full questions, selecting **ONE** full question from each **unit**.*

UNIT - I

1 a. Derive the equation for far field due to a line charge ρ_l along y-direction. Assume line charge is oriented along Z – direction. 8

b. Two changes $Q_1 = Q_2 = 10$ pC are located as in Fig. 1(b). Find E-field at point P. 6

c. Find E-field at the origin, if the following change distributions are present in free space.

i) Point charge 12 nC at p(2, 0, 6)

ii) Uniform line charge density 3 nC/m at $x = 2, y = 3$

iii) Uniform surface charge density of 0.2 nC/m^2 at $x = 2$ 6

2 a. State and explain Gauss' Law. 8

b. A point charge of 6μC is located at the origin, a uniform line charge density of 180 nC/m lies along *x*-axis and uniform sheet of charge equal to 25 nC/m^2 lies in the Z = 0 plane. Find; D at (0, 0, 4). 6

c. In certain region of space $\bar{D} = 2xy\hat{a}_x + 3yz\hat{a}_y + 4zx\hat{a}_z$. Find the amount of electric flux that passes through a portion bounded by $-1 \le y \le 2$ and $0 \le z \le 4$ in $x = 3$ plane using Gauss' law. 6

UNIT - II

3 a. Consider Fig. 3(a) and show that the work done is zero if a point change Q is moving in a circular path of radius r_1, centered around the line charge. 6

b. Three charges 3 μC, 4 μC & 5 μC are located at (0, 0, 0), (2, -1, 3) and (0, 4, -2) respectively. Find the potential at (1, 0, 1) assuming zero potential at infinity. 6

c. Find $\bar{E}$ at the point (0, 1, 1) if

(i) $V = E_0 e^{-x} \sin(\pi y/4)$..... Cartesian co-ordinates. 8

(ii) $V = E_o r \cos\theta$..... spherical coordinates

4. a. Determine whether or not the following potentials fields satisfy the Laplace's equation?

(i) $V = r\cos\phi + z$ (ii) $V = r\cos\theta + \phi$ 8

b. For the two parallel discs arrangement shown in Fig 4(b) find charge densities on the discs. 6

c. State and prove stokes theorem. 6

Contd…2

UNIT - III

5. a. Find the force on the square loop as in Fig 5(a) carrying 2 mA in the field of an infinite filament along y-axis. 6

   b. Define the following terms : 6

   (i) Torque (ii) Permeability (iii) Self-inductance.

   c. Explain the concept of magnetic boundary condition. 8

6. a. A conductor 1cm length is parallel to Z-axis & rotates at radius of 25 cm at 1200 rpm. Find the induced voltage, if radial field is $\overline{B} = 0.5\hat{a}_r\ T$ 6

   b. An area of 0.65 m^2 in the plane Z = 0 encloses a filamentary conductor. Find the induced voltage if $B = 0.05\cos 10^3 t\left(\frac{\hat{a}_y + \hat{a}_z}{\sqrt{2}}\right)$ tesla. 6

   c. Write Maxwell's equations for free space in point and integral form. 8

UNIT - IV

7. a. A 300 mHz uniform plane wave propagates through fresh water for which $\sigma = 0$, $\mu_r = 1$ and $\epsilon_r = 78$. Find attenuation constant, phase constant, wave length and Intrinsic impedance. 8

   b. Explain uniform plane wave propagation in good conductors. 6

   c. Define the following terms with respect to uniform plane waves : 6

   (i) poynting vector (ii) Skin effect (iii) SWR

8. a. Explain the following terms with respect to antennas : 8

   (i) Radiation pattern (ii) directive gain (iii) Effective aperture (iv) Effective height

   b. Briefly explain the following : 6

   i) Frii's transmission formula ii) Wave reflection from multiple interfaces

   c. With the help of diagrams explain how oscillating dipoles radiate EM energy? 6

UNIT - V

9. a. Starting from vector magnetic potential derive equation for H_ϕ component of an oscillating dipole. 8

   b. Evaluate the roughness factors for the earth at 10 MHz if $\sigma = 5$ for θ equal to 6

   (i) 30º (ii) 45º (iii) 60º

   c. List six important aspects to be considered while understanding the effect of imperfect earth. 6

10 a. What are the effects of curved nature of earth? Explain. 6

   b. Height of transmitting and receiving antennas are 49 m and 25 m respectively. Link is operating at 100 MHz with transmitted power of 100 W. Determine Los distance and received field strength. 6

   c. Find the relationship between MUF and skip distance. 8

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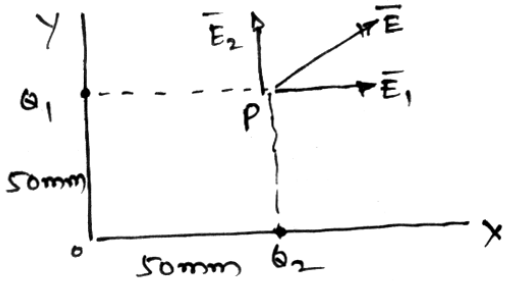

Fig 1(b)

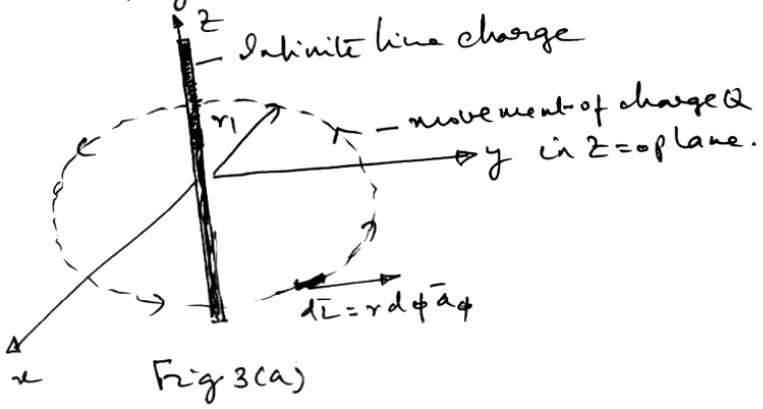

Fig 3(a)

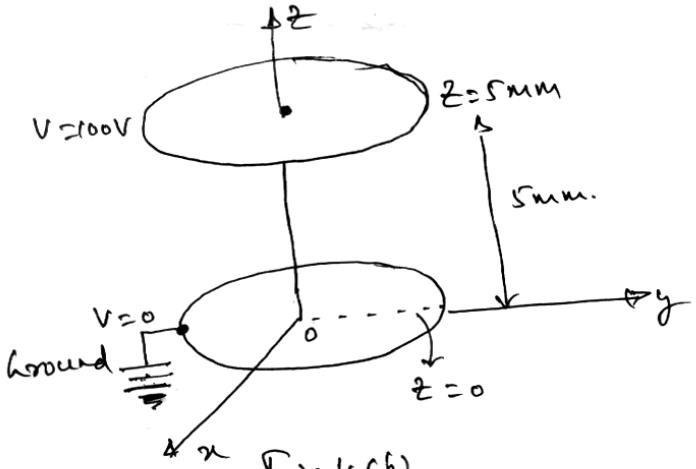

Fig 4(b)

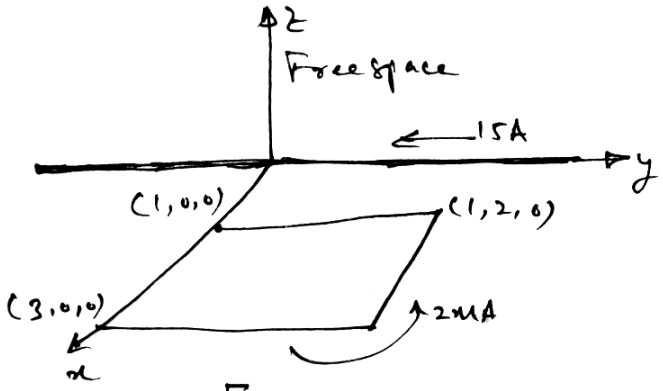

Fig 5(a)

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