Total No. of Questions—12] [Total No. of Printed Pages—4+2

Seat No.	

[4162]-158

S.E. (E & TC) (Second Semester) EXAMINATION, 2012

ELECTROMAGNETICS

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Derive an expression for electric field intensity ($\bar{E}$) at a point P due to an infinite sheet of charge placed in XY plane with a uniform charge density ρ_S. [9]

(*b*) A charge distribution is placed in the $z = -3\ m$ plane in the form of a square sheet defined by $-2 \leq x \leq 2m$, $-2 \leq y \leq 2m$. It has a charge density of $\rho_S = 2(x^2 + y^2 + 9)^{3/2}\ nC/m^2$. Find the electric field intensity ($\bar{E}$) at the origin. [9]

P.T.O.

Or

2. (*a*) Obtain the expression for $\bar{D}$ and $\bar{E}$ for an infinite line charge using Gauss law. [9]

(*b*) Three concentric spherical surfaces of radii $r = 2$, $r = 4$ and $r = 5$ m have uniform surface charge density of 8, –12 and ρ_S nC/m^2 respectively. [9]

(*i*) What must be the value of ρ_S so as to make $\bar{D} = 0$ for $r = 5$?

(*ii*) If $\rho_S = 2$ nC/m^2, find $\bar{D}$ for $0 < r < b$.

3. (*a*) What is an electric dipole ? Derive an expression for potential and electric field at point P due to an electric dipole. [8]

(*b*) Consider a capacitor formed by a segment of two co-axial cylinders as shown below in Fig. 1 : [8]

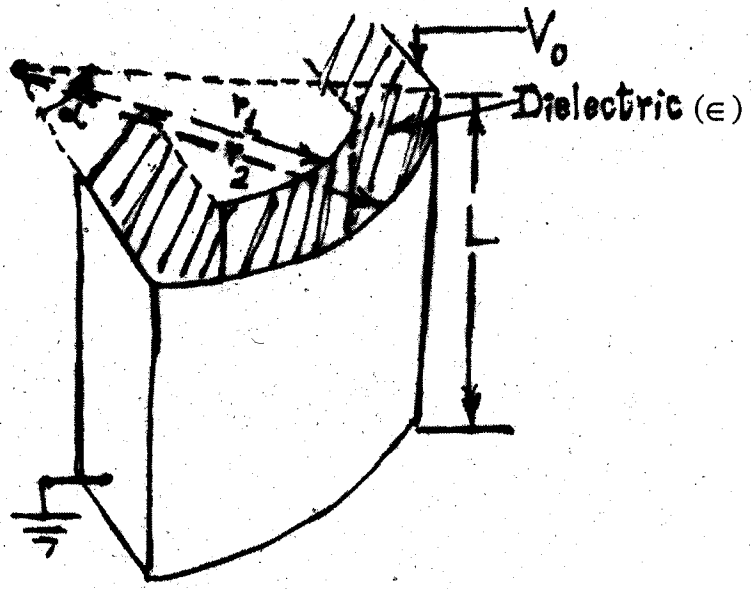

Fig. 1

For the given dimensions, find the capacitance (C). Neglect fringing.

Or

4. (*a*) Derive an expression for the capacitance of spherical capacitor with two concentric spherical conductors. [8]

(*b*) Two semi-infinite conducting planes at $\phi = 0$ and $\phi = \pi/6$ are separated by an infinitesimal insulating gap as shown in Fig. 2 : [8]

If $V(\phi = 0) = 0$ and $V(\phi = \pi/6) = 100$ V.

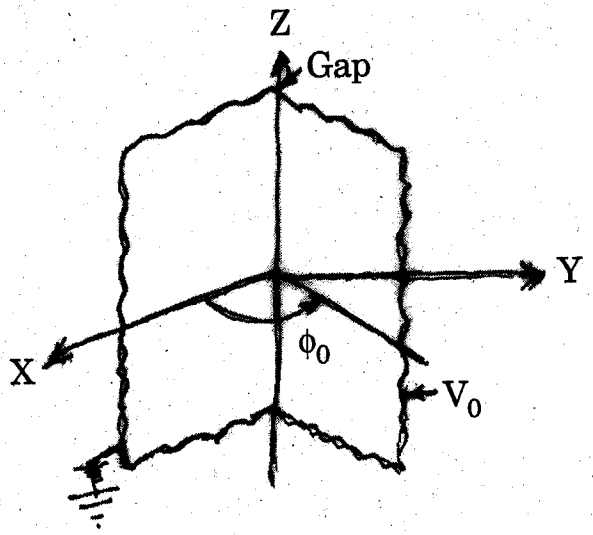

Fig. 2

Calculate V and $\bar{E}$ in the region between the planes.

5. (*a*) Derive the expression for $\bar{H}$ at a point due to an infinite sheet of current placed in $z = 0$ plane. [8]

(c) Given $\vec{E} = 60\vec{a}_x + 20\vec{a}_y - 30\vec{a}_z$ V/m at a point on the interface between air and a conducting surface. Find $\vec{D}$ and ρ_S at that point. [6]

Or

8. (a) Derive the boundary conditions for the conductor-conductor interface. [8]

(b) Given that : [10]

$$\vec{E}_1 = 2\vec{a}_x - 3\vec{a}_y + 5\vec{a}_z \text{ V/m}$$

at the charge free dielectric interface as shown in Fig. 3 below. Find $\vec{D}_2$ and angles θ_1, θ_2.

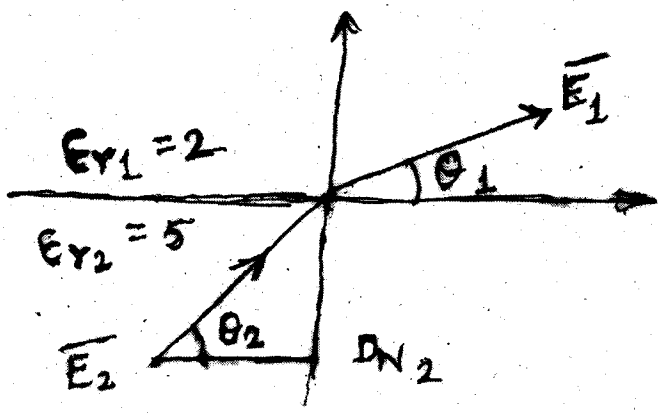

Fig. 3

9. (a) In free space $\vec{E}(2, t) = 50 \cos(\omega t - \beta_z)\ \vec{a}_x$ V/m. Find the average power crossing a circular area of radius 2.5 m in the plane z = constant. [8]

(b) State Poynting's theorem. Derive the expression for the same. Also explain about Poynting vector. [8]

Or

10. (*a*) Write Maxwell's equations in both differential and integral forms. [8]

(*b*) In the charge free region, the magnetic field intensity is given by : [8]

$$\vec{H} = H_m \cos \beta z \cos \omega t \ \vec{a}_y \ \text{A/m.}$$

Calculate $\vec{E}, \vec{D}$ and $\vec{B}$.

11. (*a*) Explain finite difference method in detail with suitable examples. [8]

(*b*) Explain method of images in detail. [8]

Or

12. (*a*) Discuss in detail about Method of Moments. What are its applications ? [8]

(*b*) Explain finite element method. [8]