(3 Hours) [Total Marks : 100

N.B. (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** from the remaining questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume suitable data whenever **required**.
(5) Vector notation should be used whenever **necessary**.

1. Attempt any **four** of the followings :— 20
   (a) Explain the concept of conservative nature of electric field.
   (b) Obtain the point form of continuity equation
   (c) Explain method of images
   (d) Explain the concept of scalar and vector magnetic potential
   (e) Define the following term :—
   $\eta, z_0, \gamma, \delta$.

2. (a) The circular region, $\rho < a$, $z = 0$, carries a uniform surface charge density ρ_s. Find $\bar{E}$ at $(0, 0, h)$, $h > 0$. 10
   (b) Evaluate both sides of the divergence theorem for the region $r \leq 2$ if $\bar{G} = 5r \sin^2 0 \cos^2 \phi \, a\bar{r}$. 10

3. (a) The volume in cylindrical coordinates between $r = 2$ m and $r = 4$ m contains a uniform charge density ρ_v (c/m^3). Find $\bar{D}$ in the regions using Gauss's law. 10
   (b) A square of side 1 m has a point charge $Q_1 = 1$ pc at the upper right corner, a point charge $Q_2 = -10$ pc at the lower right corner and a line distribution of charge $\rho_l = 10$ pc/m along the left edge. Find V at point P at the center of the square. 10

4. (a) The region $y < 0$ contains a dielectric material for which $\epsilon_{R1} = 2{\cdot}5$, while the region $y > 0$ is characterized by $\epsilon_{R2} = 4$. Let $\bar{E}_1 = -30\bar{a}x + 50\bar{a}y + 70\bar{a}z$ v/m, and find ; 10
   (a) D_{N2} (b) D_{t2} (c) $\bar{D}_2$ (d) $\bar{P}_2$ (e) θ_2 .
   (b) A filamentary current of 10 A is directed in from infinity to the origin on the positive x-axis and then back out to infinity along the y-axis. Use the Biot-Savart law to find $\bar{H}$ at P (0, 0, 1). 10

5. (a) Discuss the phenomenon of polarization in dielectric medium. Discuss how it gives rise to bond charge densities. 10
   (b) Two circular coils are located at the $z = 0$ plane and $z = 5$ m plane, centered about the z-axis. The first coil having a radius of 1 m carries a current of 10 Amp. The second coil having a radius of 0·5 m carries a current of 20 Amp. Calculate the magnetic field intensity $\bar{H}$ at (0, 0, 2·5 m). 10

6. (a) Give the general set of Maxwell's Equations in point form. Derive the set of Maxwell's Equations for static fields and harmonically time varying fields. 10
   (b) The Electric field intensity of a 300 MHz uniform plane wave in free space is given as 10
   $\bar{E}_s = (20 + j50)(\bar{a}x + 2\bar{a}y)e^{-j\beta z}$ v/m.
   (i) Find w, λ, v and β.
   (ii) Find $\bar{E}$ at $t = 1$ ns, $z = 10$ cm.
   (iii) What is $|\bar{H}|_{max}$?

7. (a) Starting with Maxwell's Equations obtain vector wave equation for lossy dielectric. Solve it by considering that $\bar{E}$ has only y-component and the wave is travelling in x-direction. Hence obtain an Expression for the complex intrinsic impedance. 12
   (b) The transmitting antenna located at the origin of co-ordinate system produces the electric field intensity $E(r,t) = \bar{a}r \, V_0 \frac{\sin\theta}{r} \cos\omega(t - r/c)(v/m)$ and the magnetic field of this antenna measured in A/m is $H(r,t) = \bar{a}\phi \frac{V}{377} \frac{\sin\theta}{r} \cos\omega(t - r/c)$ where 'C' is the velocity of light. Calculate the poynting vector the average power radiated from this antenna. 8