Paper – C3T

(Assignments – 1)

Q.1.   What are the dimensions of E in terms of the fundamental quantities M, L,T and I ?

Q.2.   Find an expression for the mechanical force per unit area on the surface of a charged conductor.

Q.3.   Calculate the torque on a dipole in an uniform electric field.

Q.4   In a region, the electric potential is expressed by $\emptyset(x, y, z) = 10(x^2 + y^2 + z^2)^{-1/2}$. Find the electric field at (2,3,4).

Q.5   Show that the vector $\vec{E} = (2xy + z^3)\hat{\imath} + x^{2\hat{\jmath}} + 3xz\hat{}2\hat{k}$ represents electrostatic fields. Also find the corresponding electrostatic potential φ; given φ=φ₀ at x=y=z=0.

Q.6.   Consider a long cylinder with a charge density proportional to the distance from its axis. i.e. $\rho(r) = kr$. where k is a constant. Using Gauss's law find the electric field at any point inside the cylinder.

Q.7.   A point dipole of moment $\vec{p} = q\hat{k}$ is placed at the origin. What is the work done in displacing a point charge q from (a,0) to 0,a) in the z-x plane.

Q.8   Find the electric field produced by an infinite cylinder of charge of volume density $\rho=5re^{-2r}$ C/m3, r being the distance from the axis of the cylinder.

Q.9. a) Show that vector $\vec{E} = yz\hat{\imath} + zx\hat{\jmath} + xy\hat{k}$ represent electrostatic field.

b) Also find the corresponding electrostatic potential φ(x,y,z) . Given that φ=φ₀ at x=y=z=0.

Q. 10. Write down Laplace's equation and show that the potential function $V=x^2+y^2-2z^2$ satisfies the Laplace's equation.

Q.11.   How much positive charge (in Coulomb) is there in a glass of water of mass 360 gms.

Q.12   A uniformly charged sphere of radius R carries a total charge Q and a volume density of charge is ρ. Show that the electrostatic energy of the charge distribution is $\frac{1}{4\pi\epsilon_o}.\frac{3Q^2}{5R}$.

Q.13   Show that the force experienced by the positive plate of a parallel plate capacitor when the voltage is kept constant is $(-\frac{q^2}{2\varepsilon_{oA}})$; where A is the plate area.

Q.14   Show that $\varphi(x, y) = e^{-y}\sin(x)$ represents an electrostatic field in free space.

Q. 15 Consider two identical spheres of radius a carrying charges q_1 and q_2 respectively and separated by a distance d (>>a). Find the electrostatic energy of the system. Is it equal to the sum of self-energies of two sphere ? Comment on the result.