Tutorial - 1

1. A chunk of silicon made in the form of a sphere of radius 100mm is given. The conductivity of silicon is 4×10^{-4} S/m, *its relative permittivity is 12 and both are* constant. Suppose that by some means, a uniform volume charge density $\rho_0 = 10^{-6}$ C/m^3 is placed in the interior of the sphere at $t = 0$. *Calculate:*

(a)The current produced by the charges as they move to the surface.

(b)The time constant of the charge decay in the silicon.

(c)The divergence of the current density during the transient.

Tutorial - 1

2. Two dielectrics meet at an interface at $x = 0$. A sinusoidal electric field intensity of peak value 5 V/m and frequency 1 kHz exists in dielectric (1). For $x < 0$, $\varepsilon = 2\varepsilon_0$, and $\mu = \mu_0$. For $x > 0$, $\varepsilon = 3\varepsilon_0$, and $\mu = 2\mu_0$. If the electric field intensity vector is incident at 30° from the normal, give the magnitudes of E and D on each side of the interface. Assume no current or charge densities exists at the interface.

Tutorial - 1

3. Suppose a submarine could generate a plane wave and use it to communicate with another submarine in seawater. If the ratio between the amplitude at the receiver and that at the transmitter must be 10^{-12} or higher, what is the maximum range of communication at

(a) 10MHz

(b) 100 Hz.

Assume relative permittivity in both cases is 72 and conductivity of seawater is 4 *S/m*.

Tutorial - 1

4. What value of A and β are required if the two fields :

$$E = 120\pi\cos(10^6\pi t - \beta x)\hat{y} \quad V/m$$

$$H = A\pi\cos(10^6\pi t - \beta x)\hat{z} \;\; \text{A/m}$$

Satisfy Maxwell's equations in a linear, isotropic, homogeneous medium with $\varepsilon_r = \mu_r = 4$ and $\sigma = 0$. Assume there are no current or charge densities in space.