Tutorial Sheet- Unit -2 (Electromagnetic Field Theory) - (2023-24)

Sub. Name: Engineering Physics **Sub. Code: BAS -201**
Date of Issue: **Date of Submission**

1. In a material for which $\sigma = 5$ S/m, $\in r = 1$, the electric field intensity is $E = 250 \sin(10^{10} t)$ V/m. Find the conduction and displacement current densities. **Ans $J_C = 1250 \sin (10^{10}t)$ A/m^2, $J_D = 22.125 \cos(10^{10}t)$A/m^2 . (2018 even).**

2. Determine the conduction current and displacement current densities in a material having conductivity 10^3 mhos/m and relative permittivity $\in r = 2.45$. The electric field in the material is given by, $E=4 \times 10^6 \sin (9\times10^9 t)$ Volt/m. **Ans $J_C = 4 \times 10^9 \sin (9 \times 10^9 t)$ A/m^2, $J_D = 780.57 \times 10^3 \cos(9 \times 10^9 t)$A/m^2.**

3. In an electromagnetic wave, the electric and magnetic fields are 100V/m and 0.265 A/m. What is the maximum energy flow? **(2022-even) .Ans: S = 26.5 W/m^2.**

4. For a medium, conductivity $\sigma = 58 \times 10^6$ Siemen/m, $\in r = 1$. Find out the conduction and displacement current densities if the magnitude of electric field intensity is given by $E = 150 \sin (10^{10} t)$ Volt/m (**2021 odd sem). Ans $J_C = 8.7 \times 10^9 \sin (10^{10} t)$ A/m^2, $J_D = 13.28 \cos(10^{10}t)$A/m^2.**

5. The earth receives 2.0 calorie/cm^{2-}-min energy from sun on its surface. Determine the amplitude of electric and magnetic field vector.
Ans: (1400 watt/m^2; E_0= 1026.80 V/m; H_0 = 2.72 amp-turn/m)

6. The relative permeability, permittivity and conductivity of aluminum are $\mu_r = 1$, $\varepsilon_r = 1$ and $\sigma = 3.5 \times 10^7$ mho/m. Find the skin depth if the wave enter in aluminum with frequency of 71.56 MHz**. Ans: (10μm)**

7. For sea water $\mu = \mu_0$, $\varepsilon = 70\varepsilon_0$ and conductivity $\sigma = 5$S/m. Find the skin depth and attenuation constant of sea water. **Ans: (0.0089 m ; 112.36 Np/m).**

8. The sunlight strikes the upper atmosphere of earth with energy flux1.38 KW/m^2.What will be the peak values of electric and magnetic fields at the points? **(2019 odd)**. **Ans: (E_0= 1019.65 V/m; H_0 = 2.706 amp-turn/m)**

9. Calculate the magnitude of the Poynting Vector on the surface of the Sun. Given power radiated by Sun is 5.4×10^{28} watt and radius of sun is 7×10^8 m. **(2018 odd**). **Ans: S = 8.7 x 10^9 W/m^2.**

10. Calculate the amplitude of electric and magnetic fields $\mathbf{E_0}$ and $\mathbf{H_0}$, at a distance of 5m from an oscillator which radiates energy isotropically at 1000W.**Ans: (E_0= 48.82 V/m; H_0 = 0.128 amp-turn/m). (EVEN 2023)**

11. Calculate the skin depth for silver at 10^8 Hz frequency. Given- for silver $\mu = \mu o$, $\mu o = 4\pi \times 10^{-7}$ N/A^2, $\sigma = 3 \times 10^7$ mhos/m. **Ans : 9.19 x 10^{-6} m. (EVEN 2023)**

12. Using Maxwell's equation, **div** $\vec{E} = \frac{\rho}{\epsilon_0}$, derive Coulomb's law of electrostatics.

13. Using Maxwell's equation, **Curl** $\vec{B} = \mu_0 \left[\vec{J} + \frac{\partial \vec{D}}{\partial t}\right]$ prove that **div** $\vec{D} = \rho$

14. If the magnitude of $\vec{H}$ in a plane wave is 1amp/m, find the magnitude of $\vec{E}$ for plane wave in free space**. Ans: E = 377 V/m.**

15. Assuming that all the energy from a 1000 Watt lamp is radiated uniformly, calculate the average values of the intensities of electric and magnetic fields of radiation at a distance of 2m from the lamp. **Ans :86.59 V/m, H = 0.23 A/m . (ODD 2023-24)**