U.G. 6th Semester Examination 2022

PHYSICS (Honours)

Paper Code : DC - 13

(Electromagnetic Theory)

Full Marks : 25 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions : 2×5=10

   (a) What is significance of Brewster angle ?

   (b) Show that in a conductor, the electric and magnetic field are no longer in phase.

   (c) The conductivity of a metal is $\sigma = 5.8\times10^{7}$ mho/m. Find out the attinuation of an electromagnetic waves of frequency 1 kHz by a metal plate of thickness 0.1 mm.

   (d) A uniform plane wave propagating in a medium has $\vec{E} = 2e^{-\alpha z}\sin\left(10^{8}t-\beta z\right)\hat{y}\ \ Y/m$.

   If the medium is characterized by $\in_r = 1$, $\mu_r = 20$ and σ=3. Find α and β by checking the nature of the medium.

   (e) An unpolarized light of intensity I_o is passed through two Nicol prisms with their principle section at 45° to each other. What is the intensity of the transmitted light ?

   (f) Whether the following potentials follow the coulomb gauge or the Lorentz gauge.

$$\phi\left(\vec{r},t\right)=0,\ \vec{A}\left(\vec{r},t\right)=\frac{1}{4\pi\in_0}\frac{qt}{r^2}\hat{r}.$$

   (g) What are the boundary conditions of *E* and *B* for *p*-polarisation ?

2. Answer any *three* questions : 5×3=15

   (a) What is skin depth ? Obtain an expression for skin depth in a conductor. 1+4

   (b) Given the electric and magnetic field vector for a plane electromagnetic wave calculate the average of (i) energy density stored in em fields (ii) poynting vector and (iii) momentum

density stored in em fields where, $\vec{E}(z,t) = E_o \cos(Kz - wt + \delta)\hat{x}$;

$\vec{B}(z,t) = \frac{1}{c} E_o \cos(Kz - wt + \delta)\hat{y}$. 1½+1½+2

(c) Define plane of vibration for a plane polarized light. Indicate, how polarized light is obtained using the "double refraction" phenomenon. 2+3

(d) Starting with Maxwells equations, derive inhomogeneous wave equation in terms of scalar potential ϕ and vector potential $\vec{A}$. 5

(e) What is optical activity ? Explain this using Fresnel's theory. 1+4

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