

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 $\sigma = 5.8 \times 10^7$ mho/m. Find out the attenuation 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 $\vec{E} = 2e^{-\alpha z} \sin(10^8 t - \beta z) \hat{y}$ Y / m. If the medium is characterized by $\epsilon_r = 1$, $\mu_r = 20$ and $\sigma = 3$. Find α and β by checking the nature of the medium.
- (e) An unpolarized light of intensity I_0 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.

$$\phi(\vec{r}, t) = 0, \vec{A}(\vec{r}, t) = \frac{1}{4\pi\epsilon_0} \frac{qt}{r^2} \hat{r}.$$

- (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

[P.T.O.]

(2)

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

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

- (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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