CITY COLLEGE

Online Internal Assessment 2021
Physics Honours
CBCS Semester – 5
Paper: CC-11: Electromagnetic Theory

Time: 1 Hour **Full Marks: 20**

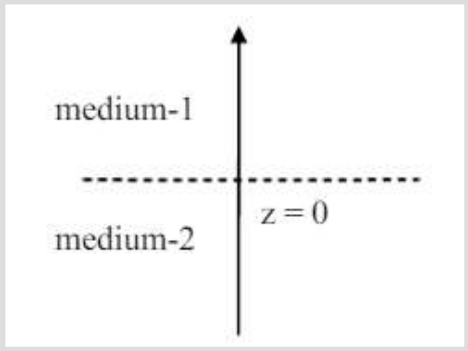
Answer any ***ten*** of the following questions:

1. Explain the terms i) plane of vibration and ii) plane of polarisation of a plane polarised light.
2. Critical angle for glass placed in air is 40^0. Calculate the angle of polarisation.
3. Prove that when light is incident at the polarising angle, the reflected beam is at right angles to the refracted beam.
4. Two polaroids are adjusted so as to obtain maximum intensity. Through what angle should one polaroid be rotated to reduce the intensity to i) half and ii) one-fourth.
5. Describe the state of polarisation of the wave represented by

$$\vec{E}(z,t) = \hat{i}E_0\cos\left(\omega t - kz + \frac{\pi}{2}\right) + \hat{j}E_0\cos\left(\omega t - kz\right)$$

6. A left circularly polarised beam (λ=580nm) is incident on a doubly refracting crystal of thickness 0.0058mm with the optic axis cut parallel to the surface. What will be the state of polarisation of the emergent beam? Given that n_o-n_e=0.15.
7. A 22cm long tube containing 88cc of sugar solution produces an optical rotation of 9.9^0 when placed in a polarimeter. If the amount of sugar in the solution is 6gm, find the specific rotation.
8. Show how Maxwell's equations in free space imply local conservation of charge.
9. Show that the Maxwell's equations can be expressed as two coupled second order differential equations in terms of scalar and vector potentials.

10. Two infinitely extended homogeneous isotropic dielectric media (medium-1 and medium- 2 with dielectric constants $\frac{\epsilon_1}{\epsilon_0} = 2$ and $\frac{\epsilon_2}{\epsilon_0} = 5$, respectively) meet at the Z=0 plane as shown in figure. A uniform electric field is given by $\vec{E} = 2\hat{i} - 3\hat{j} + 5\hat{k}$. The interface separating two media is charge free. Find electric displacement vector in the medium -2.



11. An electromagnetic wave going through vacuum is described by $E = E_0 \sin(kx - \omega t)$ and $B = B_0 \sin(kx - \omega t)$ then, proof the relation $E_0 k = \omega B_0$.

12. Calculate the skin depth for a conductor at 1 GHz, given that $\sigma = 3.8 \times 10^7$ mho/m, $\mu = 2.57 \times 10^{-7}$H/m.

13. In free space $E(z,t) = 50\cos(\omega t - \beta z)\hat{a}_x$ (V/m). Find the average power crossing a circular area of radius 2.5 m in the plane $z =$ constant.

14. Show that the magnetic part of Maxwell's equations is consistent with the wave equation in free space.

15. Show that $\vec{E} = E_0(t + \frac{z}{c})\hat{y}$ satisfies the wave equation. In which direction does this wave propagate?

Answer scripts strictly must be emailed within 30 minutes of the end of the examination to **sem5hcityphysics@gmail.com**.