R – 7468

Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, November 2023

Physics

PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2020 Admission onwards)

Time : 3 Hours

Max. Marks : 75

PART – A

Answer any **five** questions. **Each** carries **3** marks.

1. What is meant by delay distortion?
2. Explain the basic theory of holography.
3. What do you mean by "four-wave mixing" in non-linear optics?
4. Obtain the electromagnetic wave equations.
5. Differentiate between TE mode and TM mode.
6. Explain Coulomb gauge and Lorentz gauge.
7. Discuss the characteristics of quarter wave monopole antenna.
8. Explain electric dipole radiation.

(5 × 3 = 15 Marks)

PART – B

Answer any **three** questions. **Each** carries **15** marks.

9. Explain the formation of fringes in Fabry Perot interferometer. How will you use it for the measurement of wavelength of light?

10. Explain the second harmonic generation process. Obtain phase matching criterion.

11. (a) Explain reflection and transmission of em waves at oblique incidence.

    (b) Also derive an equation for snell's law from oblique incidence.

12. What is electromagnetic field tensor? Obtain the Lorentz transformation equations for the electric and magnetic fields.

13. What are TE modes? Derive an expression for the intrinsic impedance of TE mode.

14. Explain in detail the characteristics of an antenna as a radiator of electromagnetic energy.

($3 \times 15 = 45$ Marks)

PART – C

Answer any **three** questions. **Each** carries **5** marks.

15. Define X-ray diffraction. Derive an expression for Braggs law.

16. A uniform plane wave with $E = 8\cos(\omega t - 4x - 3z)a_y$ V/m is incident on a dielectric slab $(z \geq 0)$ with $\mu_r = 1.0, \varepsilon_r = 2.5, \sigma = 0$. Find the polarization and angle of incidence.

17. An airline has characteristic impedance of 70 Ω and phase constant of 3 rad/m at 100 MHz. Calculate the inductance and capacitance per meter of the line.

18. A magnetic field strength of 5 μA/m is required at a point on $\theta = \pi/2$, 2km from an antenna in air. Neglecting ohmic loss, how much power must the antenna transmit if it is a half-wave dipole?

19. Calculate the reflection coefficient for light at an air-to-silver interface $\mu_1 = \mu_2 = \mu_0$, $\varepsilon_1 = \varepsilon_0$, $\sigma = 6\times10^7 (\Omega m)^{-1}$, at optical frequencies $\omega = 4\times10^5 / s$.

20. Explain in detail the parametric generation of light.

(3 × 5 = 15 Marks)
