M. Sc. DEGREE END SEMESTER EXAMINATION : NOVEMBER 2025
SEMESTER 1 : PHYSICS
COURSE : **21P1PHYT03 : ELECTRODYNAMICS**
(For Supplementary - 2023/2022/2021 Admissions)

Time : Three Hours   Max. Weights: 30

PART A
Answer any 8 questions   **Weight: 1**

1. Give the expression for electric field of a dipole.   (R, CO 1)
2. The TEM mode has no cut off in a waveguide. Why?   (U, CO 4)
3. A dipole in an electric field might experience a torque. Explain. (U)
4. Differentiate between displacement current and electric current.   (U, CO 1)
5. Give the expression for average value of momentum density stored in an EM wave.   (U, CO 2)
6. Mention the advantages and disadvantages of Coulomb gauge.   (An, CO 3)
7. Derive wave equation for magnetic field.   (U, CO 2)
8. Draw Minkowski's diagram and explain the restriction of motion.   (U, CO 4)
9. Give the generalized expressions for both fields in an EM wave.   (U, CO 2)
10. What is generalized Coulomb field?   (R, CO 3)

(1 x 8 = 8)

PART B
Answer any 6 questions   **Weights: 2**

11. Obtain the transformation matrix for Lorentz transformation.   (A, CO 4)
12. A hollow spherical shell (with inner radius 'a' and outer radius 'b') carries a charge density rho $(p)= k/r^2$. Find the electric field in the regions, r<a, a<r<b and r>b .   (A, CO 1)
13. Find the first and second order cut off wavelengths of TM and TEM modes of a rectangular waveguide with a = 1.5 cm and b = 2 cm.   (A, CO 4)
14. Write the real fields of a monochromatic planewave traveling in negative x direction and polraized in z direction. Sketch the wave.   (A, CO 2)
15. Obtain the expression for energy of an ideal dipole in an electric field.   (A, CO 1)
16. Find the potential of a point charge moving with constant velocity.   (A, CO 3)
17. An infinite straight wire carries a current I_0, which is turned on at t = 0. Find the resulting electric and magnetic fields.   (A, CO 3)
18. Find the wavelength and propagation speed in copper for radio waves at 1 MHz.   (A, CO 2)

(2 x 6 = 12)

PART C
Answer any 2 questions   **Weights: 5**

19.   For the case of parallel plate waveguide, obtain TE solutions.   (U, CO 4)

20.   Starting from the idea of retarded potentials derive Jefimenko's equations.
      Hence arrive at Lienard Wiechert potentials.   (A, CO 3)

21.   State Poynting's theorem and obtain its integral and differential form.
      Write down Poynting's vector and give its physical meaning.   (U, CO 1)

22.   Derive Fesnel equations. Plot reflected and transmitted intensities.   (A, CO 2)
                                                                              (5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	To outline the concepts of electrodynamics.	A	1, 4, 12, 15, 21	11
CO 2	To apply Maxwell's equations and discuss EM waves	A	5, 7, 9, 14, 18, 22	12
CO 3	To apply the concepts of EM radiation	A	6, 10, 16, 17, 20	11
CO 4	To apply the concepts of (i) relativity in various cases and (ii) waveguides.	A	2, 8, 11, 13, 19	11

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;