

Reg. No

Name

22P1034

M. Sc. DEGREE END SEMESTER EXAMINATION : OCTOBER 2022

SEMESTER 1 : PHYSICS

COURSE : 21P1PHYT03: ELECTRODYNAMICS

(For Regular - 2022 Admission and Supplementary - 2021 Admission)

Duration : Three Hours

Max. Weights: 30

PART A

Answer any 8 questions

Weight: 1

1. Can we have a diamagnetic response for a ferromagnetic material? (U, CO 1)
2. Quote Maxwell's equations in free space. (R, CO 1)
3. What are paramagnetic materials? (R, CO 1)
4. Give the generalized expressions for both fields in an EM wave. (U, CO 2)
5. Give the expression for average value of Poynting vector of an EM wave. (R, CO 2)
6. What are monochromatic EM waves? Are there any natural sources emitting monochromatic EM waves? (U, CO 2)
7. What is the physical basis for radiation reaction? (U, CO 3)
8. State whether the following statement is true or false with your explanation.
Among two identical masses moving under the influence of the same force, the charged one move slowly than the uncharged one. (An, CO 3)
9. TEM mode is not supported by a rectangular waveguide. Why? (A, CO 4)
10. Explain four vector in relativistic electrodynamics. (U, CO 4)
(1 x 8 = 8)

PART B

Answer any 6 questions

Weights: 2

11. A long straight wire carrying uniform line charge is surrounded by rubber insulation out to a radius a . Find the electric displacement. (A, CO 1)
12. A hollow spherical shell (with inner radius ' a ' and outer radius ' b ') carries a charge density $\rho = k/r^2$. Find the electric field in the regions, $r < a$, $a < r < b$ and $r > b$. (A, CO 1)
13. Write the real fields of a monochromatic planewave traveling from origin to $(1,1,1)$ and polarized in z direction. Sketch the wave. (A, CO 2)
14. Find the reflectivity of air:glass interface, for normal incidence. (A, CO 2)
15. Find the radiation resistance of a wire joining the two ends of a (electric) dipole. (A, CO 3)
16. If a particle's kinetic energy is n times its rest energy, What is its speed? (A, CO 3)
17. Write electromagnetic field tensor in terms of four vector potential. Show that $F_{12} = B_3$. (A, CO 4)
18. Find the first and second order TM cut off wavelengths of an infinite parallel plate waveguide with plate separation of 1.5 cm. (A, CO 4)
(2 x 6 = 12)

PART C
Answer any 2 questions

Weights: 5

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| 19. | Obtain an expression for the electromagnetic force experienced by charges in a volume. | (U, CO 1) |
| 20. | What is a monochromatic wave? Derive wave equations for fields, in a dielectric and expression for radiation pressure. | (U, CO 2) |
| 21. | Starting from the expression for fields of a moving charge, obtain the expression for power radiated by a moving point charge. Hence describe radiation reaction and obtain the Abraham-Lorentz formula. Also discuss the 'disturbing implications' of the Abraham-Lorentz formula. | (A, CO 3) |
| 22. | Explain Minkowski space. Discuss proper time, proper velocity and Minkowski's force. Obtain relationship between them. | (A, CO 4) |
| | | (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, 2, 3, 11, 12, 19	12
CO 2	To apply Maxwell's equations and discuss EM waves	A	4, 5, 6, 13, 14, 20	12
CO 3	To apply the concepts of EM radiation	A	7, 8, 15, 16, 21	11
CO 4	To apply the concepts of (i) relativity in various cases and (ii) waveguides.	A	9, 10, 17, 18, 22	11

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