PG Even Semester Examination, May 2025

PHYSICS

(2nd Semester)

Course No.: PHY-201

(Electromagnetic Theory)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.

UNIT-I

1. (a) Write the postulates of special theory of relativity. Obtain Lorentz tranformation equation in tensor form. 2+5=7

   (b) Formulate the Lagrangian of a relativistic charge particle and from this Lagrangian obtain the equation of motion. 2+5=7

2. Derive transformation equations for electric and magnetic field vectors using Lorentz Covariants. Show that the product of electric and magnetic fields is invariant under Lorentz transformations. 7+7=14

UNIT-II

3. Discuss the motion of an electron under the comible influence of a static, uniform and othogonal electric and magnetic fields. Show that the resulting motion of the particle is a

cycloid in the plane normal to the magnetic field. 10+4=14

4. Explain the motion of a charged particle in a magnetic mirror arrangement and hence show that such an arrangement can trap a charge particle in it. 10+4=14

UNIT-III

5. (a) What is plasma? Considering the physical mechanism of plasma oscillation, derive the expression for plasma frequency. 2+4=6

   (b) Show that the relation between the electron plasma wave frequncy and plasma oscillation frequency is $\omega^2 = {\omega_p}^2 + \frac{3}{2}K^2{v_{th}}^2$, where symbols have their usual meaning. 8

6. Deduce Saha's ionization equation and discuss it. Explain why Debye shielding length increases with increase in temperature. 10+4=14

UNIT-IV

7. What is retarded potential? Derive the expression for average power radiated from a moving point chage. 2+12=14

8. (a) Consider an electron in arbitrary motion. Then show that Lienard-Wiechert potential due to this particle depends on its velocity but is independent of the extent of the charge. 7

   (b) Derive the expression for power radiated by a magnetic dipole. 7

UNIT-V

9. (a) Discuss in brief the Thomson scattering phenomena for a free charge particle. 7

   (b) Derive an expression for phase function in Mie scattering process for a spherical particle. 7

10. (a) Derive Rayleigh scattering formula for a harmonically bound charge. 8

    (b) Write notes on : T-Matrix and Discrete Dipole Approximation. 3+3=6

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