PG Even Semester (CBCS) Exam., May—2017

PHYSICS

(2nd Semester)

Course No. : PHYCC–201

(Electromagnetic Theory)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. Demanding invariance of the Lorentz force equation under Lorentz transformations, derive the transformation laws for electric and magnetic fields. 14

2. *(a)* Derive electromagnetic field tensor equation. 7

(b) Formulate the Lagrangian of a relativistic charged particle. Hence define four-potential. 5+2=7

UNIT—II

3. *(a)* Discuss the motion of a charged particle in a constant electric field. 8

(b) What do you mean by gradient drift? 6

4. Show that the magnetic moment of a charged particle moving in a spatially non-uniform magnetic field remains constant. Explain how this invariance of magnetic moment leads to the magnetic mirror effect. 8+6=14

UNIT—III

5. *(a)* What is Debye shielding? Obtain the expression for the Debye length. 2+3=5

(b) What is a plasma? Discuss the conditions for existence of plasma. 1+4=5

(c) Calculate Debye length ($_D$) and the number of particles in the Debye sphere (N_D) for the flame with n_e 10^8 cm ^{3}, T_e 0 1 keV (where 1 eV = 11605 K, k 1 381 10^{23} JK ^{1} and $_0$ 8 854 10^{12} Fm ^{1}). 4

6. *(a)* The dispersion relation for a low-density plasma is given by ^{2} $^{2}_{0}$ c^2k^2, where k is the wave vector and $_0$ the plasma frequency. Obtain a relation between group velocity and phase velocity of the plasma. 5

(b) When an electromagnetic radiation passes through a homogeneous plasma, what would be the dielectric constant of the plasma? What would be the form of Maxwell's equation in plasma neglecting thermal motion of the electrons? Discuss transverse oscillation of electrons. 2+3+4=9

UNIT—IV

7. Derive the expression of power radiated by an accelerated point charge and obtain the total power radiated. 8+6=14

8. Explain the significance of retarded potential. Derive the expressions for Lienard-Wiechert potentials for a moving point charge. 4+10=14

UNIT—V

9. Show that for Rayleigh scattering

$_{\text{bound}}$ ^{4} / $^{4}_{0}$ 14

10. *(a)* Derive the Thomson formula for scattering of electromagnetic radiation by an electron. 9

(b) Discuss in brief Mie theory for light scattering by a spherical particle. 5

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