

Roll No.

Total Pages : 3

CMDQ/D-23

5118

ELECTRODYNAMICS & PLASMA PHYSICS

Paper-PHY-301

Time allowed : 3 Hours]

[Maximum Marks : 60

Note : Attempt **five** questions in all, selecting **one** question from each unit. Question No. **1** is compulsory.

Compulsory Question

1. Attempt all questions: $4 \times 3 = 12$
- (i) What are Dirichlet and Neumann boundary conditions? Give one example for each.
 - (ii) Write Maxwell's equations in component notation using Einstein summation conventions.
 - (iii) Distinguish between TE, TM and TEM modes in waveguides. Show that TEM mode cannot propagate in a conducting waveguide.
 - (iv) In what sense Plasma is different from ionized gas? Write the fundamental equation which velocity distribution function has to satisfy in case of plasma.

UNIT-I

2. (a) Distinguish between Poisson and Laplace equations. Find the solution of three dimensional Laplace equation in rectangular coordinates. 6

- (b) Define Green's identities. Find the formal solution of boundary value problem using Green's function under Neumann Boundary Condition. 6

3. (a) What is the method of images? Deduce the expression of surface charge density induced on the grounded conducting sphere of radius a due to the presence of a point charge q located at a distance y from the center of the sphere. 9

- (b) Write the expression for Laplace equation in three dimensions using

(i) spherical polar

(ii) cylindrical coordinate systems. 3

UNIT-II

4. (a) What is second rank antisymmetric field-strength tensor with contravariant indices? Find inhomogeneous Maxwell equations in covariant form with its help. 9

- (b) Define Four vectors and draw Minkowski Space using suitable four vectors. 3

5. (a) Deduce Differential equations for scalar and vector potentials under Coulomb Gauge. Also, make a distinction between Coulomb and Lorentz Gauges. 9

- (b) Write all four Maxwell's equations in differential and integral forms. Give the physical significance of each equation. 3

UNIT-III

6. (a) In context of electromagnetic theory, establish Fresnel's relations when electric field \vec{E} is perpendicular to the plane of incidence at the interface of two dielectric media. 9
- (b) In what manner, the propagation of electromagnetic waves in conducting medium is different than that in non conducting medium? Discuss it using suitable Maxwell's equations. 3
7. (a) What is rectangular wave guide? A TM wave is travelling in a rectangular wave guide with perfectly conducting walls. Find an expression for the cut off frequency in this mode. 9
- (b) What is Larmor's formula? Give its physical significance. 3

UNIT-IV

8. (a) Derive the equations of Plasma oscillations by using Maxwell's equations. 6
- (b) Describe in details, the propagation of electromagnetic waves in Plasma containing a magnetic field. 6
9. (a) What are the conditions which plasma must satisfy? Explain Debye shielding and obtain the expression of Debye length in given plasma. 9
- (b) What do you understand by quasi-neutrality of Plasma? Why it is required for plasma? 3