(i) Printed Pages: 3 Roll No. .....

(ii) Questions : 9 Sub. Code : 3711

Exam. Code : 0473

**M.Sc. Physics 2nd Semester**

**(2054)**

**CLASSICAL ELECTRODYNAMICS–I**

**Paper : PHY-8023**

**Time Allowed : Three Hours]** **[Maximum Marks : 80**

**Note :**—Attempt **FIVE** questions in all, taking **ONE** question each from Units I to IV and the compulsory question from Unit-V.

## UNIT—I

1. (a) Discussing the case of multipole expansion of the magnetic vector potential of a localized charge distribution, calculate expression for dipole field. 10

   (b) Show that regions of higher electric field have greater energy density. 6

2. (a) Discuss the multipole expansion of energy of system of charges in an electrostatic field. Explain physical significance of each term. 8

   (b) Find an expression for the force of interaction between two equal dipoles and show that the force is repulsive when they pint towards each other and attractive when they are at right angles to the line joining them. 8

## UNIT—II

3. (a) Discussing the case of orientational polarization show that thermal agitation has no effect on polarizability of symmetric molecules. 8

(b) Derive a relation between molecular polarizability and electric susceptibility when a material of polarizable molecules is put in external electric field. 8

4. (a) A point charge is placed near a grounded conducting sphere. Find the surface density of charge induced on the sphere and force between the charge and the sphere. 9

(b) Determine energy of attraction between an electric dipole and a plane conduction surface at zero potential. 7

## UNIT—III

5. (a) What do you mean by choosing a gauge ? What is the need for choosing a gauge ? What is Gauge transformation ? Show that it is the transverse component of current density which is the source of vector potential in Coulomb gauge. 12

(b) Derive Poynting theorem for complex field vectors. 4

6. (a) Discuss briefly linearly, circularly and elliptically polarized waves, clearly explaining the difference between them. 8

(b) Discuss motion of an em wave through ionosphere. Explain the concept of critical frequency of a layer of the ionosphere. 8

## UNIT—IV

7. (a) An em wave with its electric field vector perpendicular to the plane of incidence strikes an dielectric-dielectric interface. Deduce the reflection and transmission coefficients of energy. 10

   (b) Explain the basic concept of an electromagnetic wave guide. Also explain the TE, TM and TEM modes in a wave guide. 6

8. (a) Explain the concept of retarted potentials. Also derive expressions for retarted scalar and vector potentials. 8

   (b) Two electric dipoles lying on x-axis and oriented along z-axis oscillate exactly out of phase. Their coordinates are separated by $\lambda/2$. Calculate Poynting vector at large distance. 8

## UNIT—V

9. (a) Obtain the boundary condition for the magnetic intensity vector. 3

   (b) Explain the concept of group velocity and phase velocity. 3

   (c) Give the microscopic Maxwell equations. 3

   (d) What are linear homogenous dielectrics ? 2

   (e) What do you mean by zero quadropole moment ? 2

   (f) A plane polarized em wave is incident at dielectric-metal interface. Draw the resulting wave pattern. 3