M.Sc. Semester–II (CBCS Scheme) Examination

PHYSICS

2-PHY-1 Electrodynamics–I

Time : Three Hours] [Maximum Marks : 80

N.B. :— All questions are compulsory and carry equal marks.

1. (a) State and Prove Gauss's law. 7

   (b) Differentiate between curl and divergence of a functions. 4

   (c) Obtain an expression with explanation of the electric energy for a discrete charge distribution. 5

OR

   (p) Show that electric field at any point is equal to negative gradient of potential at that point and hence derive Poisson's and Laplace's equations. 7

   (q) Prove that divergence of curl and any vector field vanishes. 4

   (r) Explain energy density in electrostatic field. 5

2. (a) Write down Laplace's equation in spherical co-ordinates and obtain its solution. 7

   (b) Explain an image method for a point charge placed at distance 'd' from infinite grounded plane at zero potential. 6

   (c) Explain how Green's function satisfies the symmetric property. 3

OR

   (p) Derive an expression for electric potential using Cartesian co-ordinates. 7

   (q) Find the potential between co-axial conducting cylinders. 6

   (r) Define Green's function in reference to electrostatic potential problems. 3

3. (a) State and prove Ampere's law and derive an expression for magnetic field due to solenoid using it. 7

   (b) Using Lorentz force equation, deduce an expression for force on a straight conductor carrying current in uniform magnetic field. 6

   (c) State Biot-Savart's law. 3

OR

   (p) Define Magnetic moment and discuss atom as a magnetic dipole. 7

   (q) Derive an expression for magnetic field due to coil of radius 'a' along its axis. 6

   (r) Define magnetic moment in case of current carrying loop. 3

4. (a) Derive Claussius-Mossotti equation. 7

   (b) Show that normal components of electric displacement density $\vec{D}$ and tangential components of electric field $\vec{E}$ on either side of interface satisfy boundary conditions. 5

   (c) Discuss susceptibility and polarizability. 4

OR

(p) What is molecular polarizability ? Discuss it on the basis of molecular model. 7

(q) Estimate the electric field inside a dielectric sphere placed in uniform electric field. 5

(r) Establish relation between $\vec{P}$, $\vec{E}$ and $\vec{D}$. 4

5. (a) State and prove Poynting vector theorem. 7

(b) Derive the relation $\nabla \times \vec{B} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$. 5

(c) What is Lorentz condition for gauge invariance ? 4

OR

(p) State Faraday's law and give its integral and differential form. 7

(q) Derive the wave equations for scalar and vector potentials. 5

(r) Prove the relation $\nabla \cdot \vec{B} = 0$. 4