Exam. Code : 224802
Subject Code : 104777

M.Sc. Physics 2nd Semester (Batch 2023-25) (CBGS)

ELECTRODYNAMICS—I

Paper : PHY–452

Time Allowed—3 Hours] [Maximum Marks—100

Note :—Attempt **FIVE** questions in all, selecting at least **ONE** question from each section. The fifth question may be attempted from any section. All questions carry equal marks.

SECTION—A

1. Determine the electric field at a distance 'z' from the centre of an infinite wire carrying linear charge density λ. The wire is located along x-axis in the x-y plane. 20

2. The electric field at a distance 'z' from an infinite wire is given by $E = \frac{\lambda}{2\pi\varepsilon_0 z}$. Extend the result obtained above to determine the electric field due to an infinite plane (x-y) carrying surface charge density σ. Do not use Gauss's law. 20

SECTION—B

3. (a) Use Biot-Savart's law to determine the magnetic field on the axis of a circular wire of radius 'R', carrying current 'I'. 14

   (b) Consider a very long cylinder carrying current such that the current density at any distance "s" from the axis is given by "J = k s". Determine the total current flowing in the cylinder. 6

4. (a) A phonograph record of radius "R", carrying a surface charge density "$\sigma = kr^2$" is set rotating at constant angular velocity "ω". Determine its magnetic moment. 14

   (b) Give units of :

   (i) Magnetic moment

   (ii) 'B' and

   (iii) 'H'. 6

SECTION—C

5. Write the Maxwell's equations in their microscopic form. What was the problem with Ampere's law and how Maxwell fixed it ? Discuss in detail. 20

6. (a) State and prove Poynting theorem. 14

(b) Consider a very long co-axial cylindrical cable with 'R_1' and '$2R_1$' as inner and outer radii. A steady current 'I_0' flows over the surface of the inner cylinder and returns via the surface of the outer cylinder. Determine the energy stored in a section of length '4L'. 6

SECTION—D

7. Consider a plane electromagnetic wave incident obliquely on the surface of a dielectric. Determine 'R' and 'T'.

8. Obtain the solution of Maxwell's equations inside a conducting medium taking direction of wave propagation along z-axis. Determine expressions for $\vec{E}(z, t)$ and $\vec{B}(z, t)$. 20