



K24P 4036

Reg. No. :

Name :

I Semester M.Sc. Degree (C.B.S.S.– Supplementary)

Examination, October 2024

(2021 and 2022 Admissions)

PHYSICS

PHY1C03 : Electrodynamics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**).

1. a) Derive the wave equation for electromagnetic wave propagation in a conducting medium and obtain its solutions. Compare the behaviour of electromagnetic waves in conducting and non-conducting media.

OR

- b) Derive the expression for the total energy radiated by an oscillating electric dipole.
2. a) Derive the expression for the reflection and transmission coefficient when an electromagnetic wave is incident obliquely on the interface between two non-conducting media.

OR

- b) Briefly explain the electromagnetic field tensor and derive the transformation equation for electric and magnetic fields. **(2×12=24)**

SECTION – B

Answer **any four** (1 mark for Part – a, 3 marks for Part – b, 5 marks for Part – c).

3. a) Derive the differential form of Gauss's law.
- b) Find the potential inside and outside the spherical shell of radius R , which carries a uniform surface charge.
- c) Briefly explain the method of images using classic image problem.

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4. a) State the Biot – Savart's law.
b) Find the magnetic field at the center of the square loop which carries a steady current I . Let R be the distance from the center to the side.
c) State and prove Poynting's theorem.
 5. a) Discuss Maxwell's correction to Ampere's law.
b) A metal sphere of radius a carries charge Q . It is surrounded out to radius b by linear dielectric material of permittivity ϵ . Find the potential at the center relative to infinity.
c) Explain the concept of gauge transformation and gauge invariance.
 6. a) Write the Laplace and Poisson equations. What is the significance of these equations in electrostatics ?
b) Explain the concept of retarded potentials.
c) A pair of copper blocks separated by a distance (d) of 3 m in x direction hold surface charge densities of $\sigma_s = \pm 2 \text{ C/m}^2$ on surfaces facing one another. If the blocks are assigned potentials $V_0 = 0$ and V_p , find the potential difference V_p .
 7. a) Distinguish between waveguides and cavity resonators.
b) What are cutoff frequencies in the context of a waveguide ? Explain their significance and how they affect wave propagation.
c) Derive Larmor's formula for the power radiated by a non-relativistic point charge.
 8. a) Write the covariant form of the continuity equation.
b) Show that $\mathbf{E} \cdot \mathbf{B}$ is relativistically invariant.
c) Write the two Maxwell's equations for $\mathbf{E}$ in covariant form. (4×9=36)
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