MPH22 — ELECTROMAGNETIC THEORY AND PLASMA PHYSICS

Time : Three hours   Maximum : 75 marks

SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

1. (a) State and prove uniqueness theorem of electrostatics regarding electric potential.

Or

   (b) Write short notes on dielectric polarisation.

2. (a) Define magnetic vector potential and discuss its utility in magnetostatics.

Or

   (b) State Ampere's circuital law. Apply this to calculate the magnetic field inside a long solenoid.

3. (a) Discuss the non-uniqueness nature of electromagnetic potentials.

Or

   (b) What is gauge transformation? Explain Lorentz gauge.

4. (a) Explain the propagation of plane electromagnetic waves in isotropic dielectric media.

Or

(b) How is the polarization of an electromagnetic waves affected when it crosses the plane interface between two dielectrics? Explain.

5. (a) Discuss the conditions for the existence of plasma.

Or

(b) Describe Debye shielding phenomena.

SECTION B — (3 × 15 = 45 marks)

Answer any THREE questions.

6. What are polar and non-polar molecules? Discuss Langevin's theory of dielectric polarisation.

7. Show the magnetic energy U_m within a magnetic material when placed in a magnetic field H is given by $U = (1/2) \int\limits_{V} \vec{H} \cdot \vec{B} \, dV$.

8. (a) Establish the integral form of Maxwell's equations.

(b) State and prove the Poynting's theorem.

9. Derive an expression for the power radiated by an oscillating electric dipole.

10. Derive the hydromagnetic equations for electrically neutral plasma in electromagnetic fields.

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