

**APRIL/MAY 2019**  
**MPH22 — ELECTROMAGNETIC THEORY**  
**AND PLASMA PHYSICS**

Time : Three hours

Maximum : 75 marks

**SECTION A — (5 × 6 = 30 marks)**

Answer ALL questions.

1. (a) Obtain the expression for potential inside and outside of dielectric sphere placed in uniform electric field.  
 Or  
 (b) Using Langevin theory of polar molecules, deduce the expression for the saturation value of polarization.
2. (a) Using Biot — Savart law derive an expression for the magnetic field due to straight conductor carrying current.  
 Or  
 (b) Explain briefly about magnetostatic energy.
3. (a) What are Coulomb and Lorentz Gauges? What are their importance?  
 Or  
 (b) Write down the Maxwell's field equations in differential form and discuss the same for  
 (i) Free space  
 (ii) Linear isotropic medium.

4. (a) Deduce an expression for the radiation field of an oscillating electric dipole.  
 Or  
 (b) What are retarded potentials? Derive the expression for the same.

- (a) Explain briefly about magneto hydrodynamic waves.  
 Or  
 (b) Write short note on Debye Shielding.

**SECTION B — (3 × 15 = 45 marks)**

Answer any THREE questions.

6. Write down Laplace's equation in spherical co-ordinates and obtain its solution.
7. A magnetized sphere of radius 'R' is placed in uniform external magnetic field  $H_0$ . Find out the potential and field inside and outside the sphere.
8. State and prove Poynting's theorem.
9. What is wave guide? For TE (Transverse Electric) waves perfectly propagating in a rectangular wave guide with perfectly conducting walls; find  
 (a) The cut off wavelength  
 (b) The velocity with which energy is transmitted along the guide.
10. Derive the Boltzmann equation for collisionless assembly of particles.

