

DECEMBER 2015

P/ID 40007/PPHG

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Time : Three hours

Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define electric monopole, dipole, quadrupole and octopole.
2. What is dielectric polarization?
3. Define magnetic vector potential and discuss its utility in magnetostatics.
4. What is hysteresis? What is the importance of this curve?
5. Comment on the correspondence of the fields B and H with E and D.
6. Discuss the usefulness of Coulomb gauge.
7. What is total internal reflection and why do we get it?
8. What is the significance of retarded potentials?
9. Define Debye length.
10. What is Pinch effect?

PART B — (5 × 6 = 30 marks)

Answer ALL questions.

11. (a) Assuming the negative charge in an atom to be distributed uniformly in a spherical volume of radius  $R$  round the nucleus, find an expression for its polarizability.

Or

- (b) Discuss the boundary conditions on field vectors at an interface between two dielectric media.

12. (a) Obtain an expression for magnetic vector potentials at a point quite far away from a stationary current distribution.

Or

- (b) Derive the energy density of magnetic field.

13. (a) Calculate the magnitude of Poynting vector at the surface of the sun and show that the solar constant is  $2 \text{ cal min}^{-1} \text{ cm}^{-2}$ .

Or

- (b) Write down the Maxwell's field equations in integral form and explain their physical meaning.

14. (a) Explain the propagation of electromagnetic waves in a conducting medium.

Or

- (b) What must be the width of a rectangular guide such that the energy of electromagnetic radiation, whose free space wavelength is 3.0 cm, travels down the guide at 95% of the speed of light?

15. (a) Describe the theory of plasma oscillations.

Or

- (b) Explain the behavior of charged particle in homogeneous fields.

PART C — ( $5 \times 10 = 50$  marks)

Answer ALL questions.

16. (a) Derive an expression for the electric field at an external point due to a dielectric medium.

Or

- (b) Give the multipole expansion of potential of charge distribution.

17. (a) Explain Biot-Savart law and from this deduce Ampere's law for steady current. Define the magnetic vector potential for steady current and show that it satisfies the Poisson's equation.

Or

- (b) 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.

18. (a) Establish Maxwell's relations for electromagnetic fields and explain their physical meaning.

Or

- (b) Obtain the Poynting's theorem for the conservation of energy in an electromagnetic field and discuss the physical meaning of each term in the resulting equation.

19. (a) Obtain the necessary relation between the incident and reflected electromagnetic field amplitudes for reflection at a plane metal surface.

Or

- (b) Find expression for the radiation field of an oscillating electric dipole. Calculate the power radiated.

20. (a) Derive the general equation for the velocity of magneto-hydrodynamic waves and find the propagation vector.

Or

- (b) Describe the theory of magnetic confinement of plasma and discuss its instabilities.
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