Reg. No. : ....

Name : ....

V Semester B.Sc. Degree (CBCSS – OBE – Regular/Supplementary/ Improvement) Examination, November 2022
(2019 Admission Onwards)
CORE COURSE IN PHYSICS
5B07 PHY : Electrostatics and Magnetostatics

Time : 3 Hours
Max. Marks : 40

PART – A

(Short answer questions. Answer **all** questions. **Each** carries **1** mark.)

1. Define Coulombs law in electrostatics. Give its equation.

2. Give the equation for the electrostatic energy of a continuous charge distribution.

3. What is electrostatic shielding ? Give one application.

4. What is a polar molecule ? Give an example.

5. Write down the integral form of Ampere's law in magnetostatics.

6. What is a linear magnetic material ?

(6×1=6)

PART – B

(Short essay questions. Answer **any six** questions. **Each** carries **2** marks.)

7. In a certain region the electric potential is given as $V(x, y, z) = 2x - 3y - z + 4$. Find the expression for the electric field.

8. Give a mathematical definition for one dimensional Dirac delta function.

9. Show that work done to move a charge between two points on an equipotential surface is zero.

10. What do you mean by bound charges ? Why they are called so ?

11. Starting from the equation $\nabla . E = \frac{\rho}{\epsilon_0}$ arrive at $\nabla . D = \rho_f$ for electric fields in matter.

12. Write down Lorentz magnetic force law for the force on a point charge q. Why magnetic forces do no work ?

13. Find the vector potential inside an infinite solenoid with n terms per unit length, radius R and current I.

14. What is meant by magnetization ? How it is related with B and H ?

(6×2=12)

PART – C

(Problems. Answer **any four** questions. **Each** carries **3** marks.)

15. Starting from the boundary condition for electrostatic field across a surface charge density, show that the derivative of electrostatic potential normal to the boundary is discontinuous.

16. The electric field in a region is given as $E = kr^3\hat{r}$, in spherical coordinates (k is a constant). Find the volume charge density ρ as a function of r.

17. A capacitor is constructed from two metal plates each having an area of 1300 cm^2. A dielectric slab of thickness 5 mm and dielectric constant 2.5 fills the space between the plates. Calculate the capacitance of the capacitor.

18. A sphere of radius R carries a polarization P(r) = kr, where k is a constant and r is the vector from the center. (a) Calculate the bound charges σ_b and ρ_b.

19. A particle with charge 2 μC is moving with a speed of 150 m/s perpendicular to a uniform magnetic field of magnitude 0.035 T. It covers a circular path of radius 60 cm. Find the mass of the particle.

20. An infinite solenoid (n turns per unit length, current I) is filled with linear magnetic material of susceptibility X_m. Find the magnetic field inside the solenoid. (4×3=12)

K22U 2330

PART – D

(Long essay questions. Answer **any two** questions. **Each** carries 5 marks.)

21. State and prove Gauss's law in electrostatics. Find the electric field due to a uniformly charged solid sphere at a point outside the sphere.

22. What happens when a dielectric is placed in external electric field ? Derive an expression for the electric potential due to a polarized object in terms of bound charge densities.

23. Explain linear, surface and volume current densities. Derive the continuity equation. Which conservation law is represented by the continuity equation ?

24. Compare the properties of paramagnetic, diamagnetic and ferromagnetic materials.

(2×5=10)

——————