

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 ?

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11. Starting from the equation $\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$ arrive at $\nabla \cdot \mathbf{D} = \rho_f$ 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 turns 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 $\mathbf{E} = kr^3 \hat{r}$, 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 $\mathbf{P}(r) = kr$, 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 $2 \mu\text{C}$ 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)

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)