



QP CODE: 26802036



26802036

Reg No :

Name :

INTEGRATED M Sc DEGREE EXAMINATION APRIL 2026

Second Semester

INTEGRATED M Sc BASIC SCIENCES - PHYSICS

CORE - IPH2CR04 - ELECTROSTATICS AND MAGNETOSTATICS

2021 Admission Onwards

7C61D1EC

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. Comment on the statement "electric charge of body is quantised."
2. State the limitation of the Coulomb's law in electrostatics.
3. Prove that the tangential component of electric field is continuous across the boundary.
4. An infinite plane carries a uniform surface charge σ . Using Gaussian pillbox, find its electric field.
5. Discuss the notion of the equipotential surface.
6. Get Poisson's equation in electrostatics.
7. Two thin long parallel wires separated by a distance R are carrying current I Amp each. Find the magnitude of force per unit length exerted by one wire on the other.
8. Discuss the Ampere's circuital law with its limitations.
9. Distinguish between Lenz's law and Fleming's right hand rule.
10. Derive the Neumann formula for mutual inductance.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.

11. Find the electric field (magnitude and direction) at a distance z above the midpoint between two equal charges, q , a distance apart. Check that the result is consistent with when $z \gg d$.





12. Obtain the expression for gradient operator in Cartesian, Cylindrical, and Spherical coordinate systems.
13. A sphere of radius 0.1 m is charged with 10^{-8} C of charge. Find the potential and electric field at any internal point.
14. Find the charge distribution giving rise to a potential of the form $V(r) = \frac{e_0}{a} \left(\frac{a}{r} + 1 \right) e^{\frac{-2r}{a}}$, where e_0 and a are constants.
15. An electron has a velocity of 106 ms^{-1} in the X direction in a magnetic field $\mathbf{B} = 0.2\hat{i} - 0.3\hat{j} + 0.5\hat{k}$ T. What is the electric field present if no net force is experienced by the electron.
16. Derive an expression for the magnetic field due to a circular loop carrying steady current along the axis of the coil.
17. Derive the relation between magnetic flux and magnetic vector potential.
18. Calculate the energy stored in the magnetic field of a solenoid of inductance 5 millihenries when a maximum current of 3.0 amp flows through it.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. Find the electric field a distance z above the center of a square loop of side a carrying uniform line charge density λ .
20. A hollow spherical shell carries charge density $\rho = \frac{k}{r^2}$ in the region $a \leq r \leq b$, where a and b are the inner and outer radius of the shell. Find the electric field in the three regions:
 - (a) $r < a$
 - (b) $a < r < b$
 - (c) $r > b$.
 Plot $|\mathbf{E}|$ as a function of r .
21. Use Gauss's law to find the electric field inside and outside a long hollow cylindrical tube, which carries a uniform surface charge σ . Check that this result is consistent with electrostatics boundary conditions.
22. Derive the magnetostatic boundary conditions of the normal component of the magnetic field.

(2×5=10 weightage)

