

403/Phs(N)

UG/4th Sem/PHY-MN-T-2/25

U.G. 4th Semester Examination-2025

PHYSICS

[MINOR]

Course Code : PHY-MN-T-2

(Electricity and Magnetism)

[NEP-2020]

Full Marks : 40

Time : 2 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **five** questions: $2 \times 5 = 10$
 - a) Draw the electric lines of force in the following cases:
 - i) Isolated positive charge
 - ii) Positive charge and negative charge kept side by side.
 - b) State and explain Lenz's law.
 - c) Write down the relation between electric field and potential. Find the electric field for the potential $V(x, y) = 5x^2 + 3y$ volts.
 - d) Explain why two electric lines of force do not intersect each other.

[Turn over]

- e) Derive the expression for the energy stored in a capacitor.
- f) With the help of suitable examples, define paramagnetic and diamagnetic materials.
- g) State and explain Poynting's theorem.
- h) Define equipotential surface.

GROUP-B

2. Answer any **two** questions: 5×2=10

- a) Write down Gauss's theorem of electrostatics. Derive the relation:

$$\vec{D} = \epsilon_0 \vec{E} + \vec{P}; \text{ all symbols have their usual physical significance.} \quad 2+3=5$$

- b) Derive the expression of the torque experienced by an electric dipole of moment $\vec{p}$ kept perpendicular to a magnetic field $\vec{E}$, write down the physical significance of $\vec{\nabla} \cdot \vec{E} = 0$. 4+1=5

- c) State and explain Ampere's circuital law. Using this law, derive the expression for the magnetic field due to a long current-carrying solenoid of infinite extent. 1+4=5

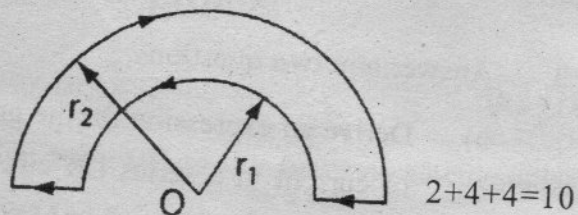
- d) Obtain an expression for the capacitance of a parallel plate capacitor and show how it is affected when the space between the plates is filled with a dielectric. Prove that the equivalent capacitance of two capacitors when connected in series is less than the capacitance of the smaller one. $3+2=5$

GROUP-C

3. Answer any **two** questions: $10 \times 2 = 20$

- a) Derive an expression for the growth and decay of current in a series LR circuit. Define time constant. Write down four Maxwell's equations, explaining each term. How the velocity of light in free space (c) can be expressed in terms of μ_0 and ϵ_0 . Then find out the value of c in SI units. $4+1+3+1+1=10$
- b) Derive the expression for the potential and electric field due to an electric dipole. Derive Coulomb's law from Gauss's law. Define Bohr magneton. Determine its value. $5+3+2=10$

- c) State and explain Biot-Savart law. Using this law, find out the expression for the magnetic field at an axial point of a circular uniform current-carrying (I) loop of radius r . Uniform current I flows in the loop shown below; Find the magnetic field at the centre of the loop for this current.



- d) State and explain Faraday's Laws of electromagnetic induction. Define magnetic susceptibility and permeability. Explain Hysteresis and Hysteresis loss. What is eddy current? Why are transformer cores laminated?
- $2+2+2+2+2=10$