

U.G. 3rd Semester Examination-2025**PHYSICS****[MINOR]****Course Code : PHY-MI-T-03****(Electricity and Magnetism)****[NEP-2020]****Full Marks : 30****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.**Symbols have their usual meaning.***GROUP-A**

1. Answer any **five** questions: **2×5=10**
- a) Obtain an expression for the mutual inductance between the primary and the secondary of a standard solenoid.
 - b) State the differential form of Gauss's Law in electrostatics.
 - c) Calculate the torque on a current loop with area A and carrying current I in a uniform magnetic field B .

[Turn over]

- d) Find the electrostatic energy stored in a capacitor of capacitance C , charged to a voltage V .
- e) Distinguish between conduction current and displacement current.
- f) What does imply? When a coil is said to have a self-inductance of 1 Henry?
- g) A point charge Q is kept at the centre of a cube. Calculate the electric flux through one face of the cube.
- h) Can the vector $k(x+y)$ be treated as an electric field, a magnetic field, or neither? (k is a constant).

GROUP-B

2. Answer any two questions: $5 \times 2 = 10$
- a) Define capacitance. How is it related to the diameter of a spherical capacitor? Find the capacitance of a cylindrical capacitor of length l , internal and external radii a and b respectively with the space being filled up by a medium of dielectric constant k . $1+1+3$

- b) Write down the differential form of Gauss's law. Using the differential form of Gauss's law, find the volume charge density ρ for an electric field. Find the corresponding potential. $1+4$
- c) State Ampere's circuital law. Apply this law to find the magnetic field inside a long solenoid. $1+4$
- d) Compare dia, para and ferromagnetic materials. 5

GROUP-C

3. Answer any one question: $10 \times 1 = 10$
- a) i) Show that, if two coils having coefficients of self-inductance L_1 and L_2 are mutually coupled, then the coefficient of the mutual inductance can be obtained as, $M = K\sqrt{(L_1 L_2)}$. What is K ? $4+1$
 - ii) What is hysteresis? Discuss the concept of remanence and coercivity of a magnetic material. $1+2+2$
 - b) i) State Maxwell's equations in electromagnetic (EM) theory. Show, by mathematical treatment, that EM waves are transverse in nature. $2+3$

- ii) If x and y components of electric vector of an electromagnetic wave are

$$E_x = a \sin(\omega t); E_y = b \sin(\omega t + \delta)$$

With the actual meaning of the symbol, show that for $\delta=2m\pi$ and $\delta=(2m+1)\pi$ the EM are linearly and elliptically polarized, respectively. Here $m=1,2,3,\dots$ $2\frac{1}{2}+2\frac{1}{2}$
