

U.G. 3rd Semester Examination-2025**PHYSICS****[MAJOR]****Course Code : PHY-M-T-03****(Electricity and Magnetism)****[NEP-2020]**

Full Marks : 40

Time : $2\frac{1}{2}$ 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: $2 \times 5 = 10$

- a) How does the capacitance of a parallel-plate capacitor change if the area of the plates is doubled?
- b) Define electric flux and state its SI unit.
- c) Explain why the divergence of the magnetic field is zero.
- d) Calculate the electric potential at a distance of 0.5 m from a point charge of $10 \mu\text{C}$.

[Turn over]

- e) Define relative permeability and state its relationship with magnetic susceptibility.
- f) A magnetic flux through a coil changes from 10 Wb to 2 Wb in 0.1 s. Find the induced EMF.
- g) Define power factor and state its value for a purely resistive circuit.
- h) What is Critical Damping Resistance (CDR)?

GROUP-B

2. Answer any two questions: $5 \times 2 = 10$

- a) Explain the B-H Hysteresis loop with a diagram. Define Retentivity and Coercivity. What is Hysteresis Loss? $2+2+1$
- b) Find the work done to bring a $5 \mu\text{C}$ charge from infinity to a point where the potential is 200 V. If the charge is moved further to a point at 250 V, find the additional work. Is the work done path-dependent? $2+2+1$
- c) Define polarization of a dielectric medium. Find the relation between dielectric constant with polarization and electrified. Calculate the electric susceptibility. $1+2+2$

- d) A solenoid has 1000 turns/m and carries 2 A. Find the field B at the center. Find the field B at one end of the solenoid. What is the field outside an ideal solenoid? $2+2+1$

GROUP-C

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

- 3.
 - a) State the Uniqueness Theorem in electrostatics.
 - b) Explain why the surface of a conductor in equilibrium must be an equipotential surface.
 - c) A point charge $q = 2\text{C}$ (Coulomb) is placed 10 cm away from an infinite grounded conducting plane. Calculate the force of attraction between the charge and the plane.
 - d) Also calculate the electrostatic potential at a point exactly midway between the charge and the plane. $2+2+(3+3)$
- 4.
 - a) State Biot-Savart's Law in vector form.
 - b) Explain the concept of Magnetic Vector Potential A and its relation to B.
 - c) Calculate the magnetic field at the center of a circular loop of radius 5π cm carrying a current of 10 A.

- d) Two long parallel wires are separated by 5 cm and carry currents of 2 A and 4 A in the same direction. Calculate the force per unit length between them. 2+2+3+3
5. a) Define the Time Constant of an L-R circuit and explain its significance during the growth of current.
- b) State the Reciprocity Theorem as applied to mutual inductors.
- c) In a C-R circuit, $C = 10 \text{ F}$ and $R = 1 \text{ M } \Omega$. Calculate the time taken for the capacitor to lose 50% of its initial charge during discharge.
- d) Two coils have self-inductances $L_1 = 4 \text{ mH}$ and $L_2 = 16 \text{ mH}$. If the mutual inductance is 4 mH, calculate the coefficient of coupling. 2+2+3+3
6. a) State Thevenin's Theorem and draw its equivalent circuit.
- b) Define Charge Sensitivity and Current Sensitivity of a Ballistic Galvanometer.
- c) A DC source of 12 V has an internal resistance of 3Ω . Calculate the maximum power it can deliver to an external load.
- d) A Ballistic Galvanometer gives a first throw of 15 cm. If the logarithmic decrement λ is 0.1, calculate the corrected (undamped) throw. 2+2+3+3