

301/Phs(N)

UG/3rd Sem/PHY-M-T-03/25

**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: 2×5=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]*

- c) 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: 5×2=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:

10×2=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  $5\pi$  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 3  $\Omega$ . 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  $\lambda$  is 0.1, calculate the corrected (undamped) throw. 2+2+3+3