

2 0 1 7

PHYSICS

(Major)

Paper : 3.2

(Current Electricity and Magnetostatics)

Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer the following questions : 1×7=7

- (a) Define electric current and current density.*
- (b) State the law of Faraday for electromagnetic induction.*
- (c) What is a thermoelectric diagram?*
- (d) What is RMS value of alternating voltage?*
- (e) Mention two uses of transformer.*

(2)

- (f) What do you mean by surface current density and volume current density?
- (g) What is magnetic vector potential?

2. Answer the following questions : $2 \times 4 = 8$

- (a) The resistances of the four arms of a Wheatstone's network are 5, 5, 5 and 5.2 ohms. The resistance of the galvanometer is 40 ohms and the battery supplies a current of 0.2 ampere. Calculate the current through the galvanometer.
- (b) A charged capacitor of capacitance $0.01 \mu\text{F}$ is made to discharge through a circuit consisting of a coil of inductance 0.1 henry and an unknown resistance. What should be the maximum value of the unknown resistance, if the discharge of the capacitor is to be oscillatory?
- (c) The current sensitivity of a ballistic galvanometer is 2.2×10^{-9} ampere for a deflection of 1 mm on a scale kept at a distance of 1 meter. Calculate the charge sensitivity of the galvanometer if time period of the coil is 6.2 seconds.
- (d) Find the magnetic induction at the centre of a square current loop of side 1 meter carrying a current of 1 ampere.

(3)

3. Answer any three of the following questions : $5 \times 3 = 15$

- (a) Explain with circuit diagram, how you can measure a low resistance with the help of a Kelvin double bridge. 5
- (b) What is meant by resonance in an a.c. circuit? In an a.c. circuit containing L , C and R in series, find the condition under which the resonance is obtained. $2+3=5$
- (c) What do you mean by Peltier and Thomson effects in thermoelectricity? Establish the relation

$$\pi_2 - \pi_1 = \frac{\pi_1}{T_1} (T_2 - T_1)$$

where π_1 and π_2 are Peltier coefficients. $1+1+3=5$

- (d) Show that for a current loop, the magnetic scalar potential is

$$\phi_m = \frac{\mu_0}{4\pi} I \Omega$$

where the symbols have their usual meanings. 5

- (e) Calculate the value of the torque on a current loop placed in a uniform magnetic field. 5

4. What is meant by mutual inductance? Describe with circuit diagram, how the mutual inductance can be measured using ballistic galvanometer. 2+8=10

Or

Obtain an expression for the growth and decay of charge in a capacitor through a resistance. What is the power expended in a series $L-C-R$ circuit at resonance? 8+2=10

5. Describe the construction, working and theory of an AC dynamo. 10

Or

Discuss the theory of transformer and also discuss its working. Describe the various losses occurring in a transformer. 6+2+2=10

6. Derive an expression for the flux density at a point inside a long solenoid. Hence prove that the density at the end of an infinitely long solenoid is double as much as that at its middle. 5+5=10

Or

State Biot-Savart law. Using Biot-Savart law, calculate the value of magnetic field due to an infinitely long straight wire carrying a current i ampere at a distance d from the wire. 2+8=10

★ ★ ★