

3 (Sem-3) PHY M 2

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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.

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

2. Answer the following questions : 2×4=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. Answer any three of the following questions : 5×3=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
