2017

PHYSICS

(Major)

Paper : 3.2

(Current Electricity and Magnetostatics)

Full Marks: 60

Time: 3 hours

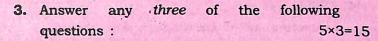
The figures in the margin indicate full marks for the questions

1. Answer the following questions:

 $1\times7=7$

- (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.

- What do you mean by surface current density and volume current density?
- What is magnetic vector potential?
- $2 \times 4 = 8$ Answer the following questions:
 - The resistances of the four arms of a (a) Wheatstone's network are 5, 5, 5 and 5.2 ohms. The resistance of the galvanometer is 40 ohms and the current battery supplies a 0.2 ampere. Calculate the current through the galvanometer.
 - A charged capacitor of capacitance 0.01 µF 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?
 - 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.
 - Find the magnetic induction at the centre of a square current loop of side 1 meter carrying a current of 1 ampere.



- (a) Explain with circuit diagram, how you can measure a low resistance with the help of a Kelvin double bridge.
- 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.
- 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

5

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.

Calculate the value of the torque on a current loop placed in a uniform magnetic field.

8A/65

(Turn Over)

5

(Continued)

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 expanded 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
