

Total number of printed pages-4

3 (Sem-3) PHY M 2

2021

(Held in 2022)

**PHYSICS**

(Major)

Paper : 3:2

**(Current Electricity and Magnetostatics)**

Full Marks : 60

Time : Three hours

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

1. Answer the following questions :  $1 \times 7 = 7$ 
  - (a) Write down the continuity equation that relates the charge density and current density at a point.
  - (b) Define current sensitivity of ballistic galvanometer.
  - (c) When does a series L-C-R circuit have the maximum impedance and what is its value ?

Contd.



(d) In a region, the force  $\vec{F} = q(\vec{v} \times \vec{B})$  on a charge  $q$  is zero. What conclusions can you draw from it ?

(e) How does a current loop behave as a magnetic dipole ?

(f) What do you mean by 'phasor diagram' ?

(g) The  $\text{div } \vec{B} = 0$ . Explain its significance.

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

(a) Draw the circuit diagram of Kelvin's double bridge for the measurement of low resistance.

(b) In an oscillatory circuit,  $L = 0.2$  henry,  $C = 10.002 \mu F$ . Find the maximum values of the resistance so that the circuit may oscillate.

(c) What do you mean by Q-factor of an a.c. series resonant circuit ?

(d) Distinguish between 'magnetic vector potential' and 'magnetic scalar potential'.

3. Answer **any three** of the following questions :

$5 \times 3 = 15$

(a) Discuss the growth of a current in a circuit containing inductance, resistance and a constant source of e.m.f. What is time constant of the circuit ?

(b) Obtain an expression for the power factor of an a.c. circuit. Explain the term 'Wattless current'.

(c) What is thermoelectric power ? Considering the electromotive force ( $e$ ) as

$$e = \pi_2 - \pi_1 - \int_1^2 (\sigma_A - \sigma_B) dT$$
, find an expression for thermoelectric power.

(d) Obtain an expression for force and torque on a current loop in a uniform magnetic field.

4. (a) What is a ballistic galvanometer ? In case of ballistic galvanometer, establish

$$\text{the relation } q = \frac{T}{2\pi} \cdot \frac{C}{\eta AB} \theta_0$$

where  $\theta_0$  is the angle through which the suspension fibre is twisted.  $1+7=8$

(b) State Kirchoff's Voltage law and give its significance. 2



**Or**

Find with vector diagrams, the impedances of circuits consisting of (a) an inductance and resistance in series, and (b) a capacitance and a resistance in series when a source of alternating e.m.f. is applied across them. 5+5=10

5. What is magnetic vector potential ? Find the vector potential due to an electric current flowing in a wire at a point outside the wire and hence calculate the magnetic flux density  $\vec{B}$ . 2+6+2=10

**Or**

A d.c. e.m.f. is suddenly applied to a circuit consisting of a resistor  $R$  and capacitor  $C$  in series. Write the e.m.f equation for the circuit and hence the current at any instant. What is meant by time constant and what is its significance ? 2+6+2=10

6. Derive the relations  $\pi = T \frac{dE}{dT}$  and  $\sigma_b - \sigma_a = T \frac{d^2E}{dT^2}$  for Peltier and Thomson effects. Show how various co-efficients are represented on a thermoelectric diagram. 3+4+3=10

**Or**

State Biot-Savart Law in magnetostatics. Using this law, obtain an expression for the magnetic field at a point on the axis of a circular coil carrying current. 2+8=10