53 (IE-402) ELMI

2017

ELECTRICAL MEASUREMENTS AND INSTRUMENTS

Paper : IE-402

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* Describe the construction and working of a ballistic galvanometer.

   Explain in brief the basic principle of operation of a d'Arsonval galvanometer. 8

   (b) Describe the construction of attraction and repulsion type moving Iron instruments. 6

(c) Explain the principle of working of thermocouple instruments with a suitable diagram. 6

2. (a) Show that in a Electrodynamometer type instrument, the deflection θ under a.c. operation is given by the relation :

$$\theta = \frac{I_1 I_2}{K} \cos\phi \frac{dM}{d\theta}$$ 8

(b) Describe the working of a Quadrant Electrometer or Quadrant type Electrostatic instruments. Discuss the conditions of its operation. 6

(c) Describe the constructional features of potential Transformer and draw the equivalent circuit diagram and the phasor diagram. 6

3. (a) Describe the theory of Electrodynamometer Wattmeter with mathematical expressions. 7

(b) Derive that the total deflecting torque T_d in an Induction type meter is given by the relation : 7

$$T_d = K\phi_1 \phi_2 \frac{f}{z} \sin\beta \cos\alpha$$

(c) Explain the constructional features of Single Phase Induction type Energy Meters. Also draw the phasor diagram. 6

4. (a) Sketch the circuit diagram of a basic D.C. Potentiometer. Discuss the calibration procedures for the Potentiometers and explain how it may be used for precise measurement of D.C. voltages. 6

(b) Explain the Direct Deflection Method for the measurement of insulation resistance of cables. 6

(c) Derive the expression for bridge sensitivity for a Wheatstone bridge with equal arms. 8

In a Wheatstone bridge, the values of resistances of various arms are $P = 500\Omega$, $Q = 200\Omega$, $R = 720\Omega$ and $S = 330\Omega$. The battery has an *emf* of $5V$. The galvanometer has a current sensitivity of $5mm/\mu A$ and an internal resistance 10Ω. Calculate the deflection of galvanometer.

5. (a) Explain how a D.C. Potentiometer can be used for following applications ? 8

(i) Calibration of ammeter

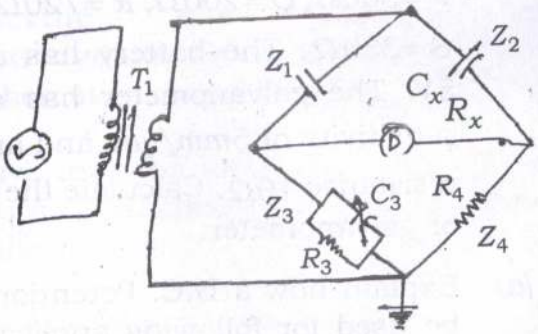
(ii) Measurement of resistance

(iii) Calibration of wattmeter.

(b) A high-voltage capacitor is investigated using a Schering bridge as shown in the figure below. The bridge components at balance are following :

$C_1 = 0{\cdot}3\,\mu F$, $C_3 = 1000\,pF$, $R_3 = 2k\Omega$ and $R_y = 5k\Omega$.

The supply is $1000\,V$ with a $300\,Hz$ frequency. Calculate the measured capacitance (C_x) and its dissipation factor, and determine the approximate magnitudes of the voltage drop across z_2 and z_4. 6



(c) Describe in brief the construction and working of Earth Tester. 6

6. (a) Draw the circuit diagram of a Maxwell bridge. Explain the bridge operation, and derive the equations for the inductor under investigation.

A Maxwell bridge uses a standard Capacitor of $C_3 = 0{\cdot}3\mu F$ and operates at a supply frequency of $200Hz$. Balance is achieved when $R_1 = 1{\cdot}5k\Omega$, $R_3 = 550\Omega$ and $R_y = 300\Omega$. Calculate the inductance and resistance of measured inductor, and determine its Q factor. 8

(b) Discuss a method for the measurement of Mutual inductance. 7

(c) A Wien bridge circuit has the following components $C_1 = 0{\cdot}2uF, C_2 = 0{\cdot}4uF$, $R_1 = R_2 = 820\Omega$, $R_3 = 1{\cdot}5k\Omega$. Calculate the bridge balance frequency, and the required resistance for R_4 to achieve balance. 5

7. *(a)* Write short notes on : ***(any three)*** 6×3=18

(i) Gall Tinsley (Coordinate) type Potentiometer.

(ii) Kelvin Double Bridge

(iii) Localization of cable faults

(iv) Anderson Bridge.

(b) List the following for PMMC, M-I and Electrodynamometer type instruments 2

(i) Type of operation

(ii) Operating range