53 (IE 402) ELMI

2015

ELECTRICAL MEASUREMENTS & INSTRUMENTS

Paper : IE 402

Full Marks : 100

Time : Three hours

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

*Answer **any five (5)** questions.*

1. (a) Why the ammeters and voltmeters are connected in series and parallel respectively ? 4

   (b) Describe the principle of operation of a d'Arsonval galvanometer. 6

   (c) How the range of d.c. ammeter and d.c. voltmeter can be extended ? 4

Contd.

(d) A milli-ammeter of 2.5Ω resistance reads upto $100mA$. Calculate the resistance which is necessary to enable it to use as :　　　　　6

　* a voltmeter reading upto $20V$

　* an ammeter reading upto $10A$.

2. (a) Define Wattmeter. To measure the power in a 3-phase circuit, what are the different arrangements of wattmeter ?　　　　$2+6=8$

(b) Explain the electrodynamometer type wattmeter. Derive the expression for torque. Why it is necessary to make the potential coil circuit purely resistive ?　　　　7

(c) A wattmeter has a current coil of 0.03Ω resistance and a pressure coil of $6k\Omega$ resistance. Calculate the %age error if the wattmeter is so connected that both current coil and pressure coil are on load side. If the load takes $20A$ at a voltage of $220V$ and p.f. 0.6 in each case,

what load current would give equal errors with the two connections ?

　　　　5

3. *(a)* List the application of potentiometer.

2

(b) How *dc* potentiometer can be used for —
   * calibration of wattmeter
   * calibration of ammeter.   4+4=8

(c) Using a cadmium cell of 1·0183V and a standard resistance of 0·1Ω a potentiometer was adjusted so that 1·0183m was equivalent to the emf of the cell, when a certain direct current was flowing the standard resistance, the voltage across 1 correspond to 150cm. What was the value of current?

5

(d) Explain the term 'standardization of a potentiometer'. Describe the procedure of standardization of a *dc.* potentiometer.   5

4. *(a)* Draw the circuit diagram of a Crompton's potentiometer and explain its working.   5

(b) Define the following terms as used for instrument transformer : 5

      * Transformation ratio

      * Nominal ratio

      * Turns ratio

      * Ratio error

      * Burden.

(c) Discuss the major sources of errors in current transformers. 5

(d) What is potential transformers ? State the differences between CT and PT.

                                           5

5. *(a)* The ammeter voltmeter method is used to measure the resistance of an aircraft instrument. With the voltmeter connected across the resistance, the readings on the ammeter and voltmeter are $0.3A$ and $2.4V$ respectively. The resistance of the voltmeter is 450Ω. Calculate —

(i) true value of resistance

(ii) %age error in the value of resistance if the voltmeter current is ignored. 6

(b) The value of high resistance is measured by loss of charge method. A capacitor having a capacitance of $2 \cdot 5\mu F$ is charged to a potential of 500V d.c. and is discharged through the high resistance. An electrostatic voltmeter kept across the high resistance reads the voltage as 300V at the end of 60 *seconds*. Calculate the value of high resistance. 6

(c) Describe the construction and working of meggar with the help of neat sketch. 5

(d) Explain the significance of using four terminals for measurement of low resistance. 3

6. (a) Discuss Maxwell's bridge for measurement of inductance. For what range of Q-factor of coil, the bridge is suitable ? 6

(b) Explain the working principle of Schering Bridge and derive an expression for measurement of unknown capacitor. 8

(c) Find the series equivalent inductance and resistance of the network that causes an opposite angle (Hay Bridge) to null the following bridge arms : 6

$$w = 3000\,rad/s; \quad R_2 = 9k\Omega; \quad R_1 = 1.8k\Omega$$
$$c_1 = 0.9\mu F \quad \text{and} \quad R_3 = 0.9k\Omega$$

7. *(a)* With the help of circuit diagram derive the balance conditions of Owen bridge arrangement. State its advantages and disadvantages. 10

(b) What do you mean by low, medium and high resistance ? Describe *one* method for the measurement of medium resistance with its advantages and disadvantages. 10

8. Write short notes on : *(any four)*

5×4=20

* Anderson bridge

* Wheatstone bridge

* LPF wattmeters

* Drysdale (Polar type) potentiometer

* MI and MC-meters.