2018

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 dynamic behaviour of Galvanometer and derive the expression for deflection θ. Also, discuss the response of the Galvanometer under different conditions.   10

    (b) Explain the difference in constructional details of Ballistic Galvanometer and a d'Arsonval Galvanometer.   5

(c) The inductance of a moving iron instrument is given by :

$$L = (50 + 2\theta - \theta^2)\mu H$$

where θ is the deflection in radian from zero position. The spring constant is 12×10^{-6} Nm/rad. Estimate the deflection for a current of 2A.   5

2. (a) Describe the constructional details and working of an electrodynamometer type instrument. Also, derive the equation for deflection under a.c. operation.   10

(b) Derive the expression for a electrostatic type of instrument using spring control.   5

(c) Explain the working of a Quadrant Electrometer using a suitable diagram.   5

3. (a) Explain the working of a rectifier type of Voltmeter using a suitable diagram.   5

(b) A basic d'Arsonval movement with a full scale reading of 100mA and an internal resistance of 1000Ω is available. It is to be converted into a 0-1A, 0-10A, 0-100A multirange Ammeter, calculate the value of the individual shunts.   6

(c) Describe the working of a Current Transformer. Also, draw the equivalent circuit and phasor diagram.   9

4. (a) Explain the construction and basic principle of operation of an Energymeter. Show that in a single phase Energymeter, the total number of revolutions of the disc is directly proportional to energy.   10

(b) Describe the following applications of D.C Potentiometer with suitable diagrams :   10

(i) Calibration of Voltmeter

(ii) Calibration of Ammeter

(iii) Measurement of unknown resistance

(iv) Measurement of Power.

5. (a) Describe a method for the measurement of the following :   10

   (i) Insulation resistance

   (ii) Earth resistance.

   (b) Derive the expression for bridge sensitivity for a Wheatstone bridge. Also, determine the expression for the current through the Galvanometer in the Wheatstone bridge.   10

6. (a) The four arms of a Maxwell's capacitance bridge at balance are : arm ab, an unknown inductance L_1, having a resistance R_1; arm bc a non-inductive resistance of 1000Ω; arm cd, a capacitor of $0.5\mu F$ in parallel with a resistance of 1000Ω; arm da, a resistance of 1000Ω.

   Derive the equations of balance for the bridge and determine the value of R_1 and L_1.   5

   (b) Describe a method for the measurement of unknown capacitance.   5

   (c) Draw the diagram of Anderson's bridge and derive the equations of balance.   6

   (d) Using a suitable diagram, explain how eddy current damping is produced in an electrical instrument.   4

7. Write short notes on : *(any two)* $10\times2=20$

   (i) M.I. Instruments

   (ii) A.C. Potentiometer

   (iii) Megger

   (iv) Vibration Galvanometer.