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) Derive the torque equation of a moving iron instrument.   7

    (b) Describe the constructional features and working of attraction and repulsion type moving iron instrument.   8

    (c) Show that in an electrostatic instrument, the deflection θ is given by the relation   5

    $$\theta = \frac{1}{2} \frac{V^2}{K} \frac{dL}{d\theta}$$

2. (a) Why is damping required for an electromechanical measuring instrument ? Describe Eddy current damping with a suitable diagram. 6

   (b) Explain the different effects used in producing deflecting torque in an analog instrument. 8

   (c) The following data refers to a moving coil galvanometer whose resistance is 320Ω and a resistance of 1250Ω is connected in series with it.

   Number of turns = 200,
   flundensity = $0\cdot1\,Wb/m^2$,
   control constant = $0\cdot15\times10^{-6}Nm/rad$,
   dimension of the coil = $40\times50mm$,
   moment of inertia of coil = $0\cdot3\times10^{-6}kgm^2$.
   Calculate :

   (a) The resistance to be connected to galvanometer for critical damping

   (b) Relative Damping.

   6

3. (a) Write the advantages and disadvantages of PMMC instrument. 5

   (b) Describe the construction and working of hot wire instruments. 5

(c) Derive the relation for Inductance and Quality factor for Maxwell Bridge.

Given that

ARM AB = R_1 and series inductor L_1
$\quad$ BC = R_2,
$\quad$ CD = R_4 parallel to capacitor C_4,
$\quad$ DA = R_3

Detector is connected between BD and supply is connected to AC at balance condition. $\qquad$ 5

(d) Write down the errors in A.C. bridge methods and their compensation techniques. $\qquad$ 5

4. (a) Describe the construction of Electrodynamometer Wattmeter. Show that the deflection θ in Electrodynamometer Wattmeter is given by the relation : $\qquad$ 10

$$\theta = \left(K_1 \, dM\big/_{d\theta}\right) P$$

(b) Derive the equation for deflecting torque in an Induction Type Energymeter. $\qquad$ 7

(c) Discuss in brief the errors in Energymeter. $\qquad$ 3

5. *(a)* Differentiate between C.T. and P.T. Draw the equivalent circuit diagram and phasor diagram for C.T.   6

(b) Explain the term "standardization" of a Potentiometer. Describe the procedure of standardization of a D.C. Potentiometer. Also, discuss some of the applications of D.C. Potentiometer.   10

(c) A Maxwell Inductance Bridge uses a standard capacitor of $C_3 = 0{\cdot}1\mu F$ and operates at a supply frequency of $100H_2$. Balance is achieved when $R_1 = 1{\cdot}26K\Omega$, $R_3 = 470\Omega$ and $R_4 = 500\Omega$. Calculate the

(i) Inductance

(ii) Resistance of the measured inductor

(iii) θ factor   4

6. *(a)* Derive the relation for frequency in a Wien Bridge where arm AB consists of resistance R_1 and a series capacitor C_1, arm BC consists of resistance R_2, arm CD consists of resistance R_4, and arm DA consists of parallel combination of resistance R_3 and capacitor C_3.   5

(b) Draw a neat diagram of vibration galvanometer and explain its working.

5

(c) Derive the expression for Q of coil for series RL, series RC, parallel RL and parallel RC combination.

10

7. (a) Write short notes on : *(any two)*

$7 \times 2 = 14$

(i) Megger

(ii) Kelvin Double Bridge

(iii) A.C. Potentiometer.

(b) Describe a method for the measurement of insulation resistance.

6

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(b) Draw a neat diagram of vibration galvanometer and explain its working. 5

(c) Derive the expression for Q of coil for series RL, series RC, parallel RL and parallel RC combination. 5+5=10

7. (a) Write short notes on : (any two) 7×2=14

(i) Megger

(ii) Kelvin Double Bridge

(iii) A.C. Potentiometer.

(b) Describe a method for the measurement of insulation resistance. 6