53 (IE 402) ELMI

2014

ELECTRICAL MEASUREMENTS AND INSTRUMENTS

Paper : IE 402

Full Marks : 100

Pass Marks : 30

Time : Three hours

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

*Answer **any five** questions out of seven.*

1. *(a)* Explain the mechanism of PMMC movement. 5

(b) A moving coil *milli-voltmeter* has a resistance of 200Ω and full-scale deflection is reached when a potential difference of $100mV$ is applied across its terminals. The moving coil has effective dimensions of $30 \times 25mm^2$ and is wound with 100 turns. The flux density in the gap is $0 \cdot 2 wb/m^2$. Determine the control constant of the spring if the final deflection is 100° and suitable diameter of copper wire for the coil winding of 20% of total instrument resistance is due to coil winding.

Resistivity of copper is $1 \cdot 7 \times 10^{-8} \Omega$-$m$. 10

(c) Compare merits and demerits of moving coil and moving iron instruments. 5

2. (a) Give the basic principle of working of an electrostatic voltmeter. Explain how the voltage range of the voltmeter can be increased. 5+5

(b) A basic D'Arsonval movement has a current sensitivity $0 \cdot 1mA$ and internal resistance of 500Ω. With the help of neat diagram, explain how it can be converted to a multi-range voltmeter which has the following range $10V$, $50V$, $100V$. 5

(c) A series ohmmeter has a movement of 60Ω internal resistance. If full-scale deflection current is $1 \cdot 2mA$, internal battery voltage is $3V$, and the desired scale marking for half-scale deflection is 1500Ω.

Determine R_1 & R_2

R_1 = Current limiting resistor

R_3 = Zero adjusting resistor. 5

3. (a) Explain the procedure of measuring a low resistance with the help of Kelvin's double bridge. Derive the relation for unknown resistance. 10

(b) What is the principle of using loss of charge technique for measurement of high resistance ? Derive necessary relation.

A length of cable was tested for insulation resistance using loss of charge method. A capacitance formed by sheath of cable of $300pF$ is found to have drop in voltage from $300V$ to $100V$ in 120 seconds. Calculate the insulation resistance of the cable. 6+4

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4. *(a)* Explain the working principle of schering bridge and derive an expression for measurement of unknown capacitor. Draw the phasor diagram under null condition and explain how dissipation factor of the capacitor can be calculated. 6

(b) An ac bridge is connected as follows :

Branch AB is an inductive resistor, branches BC and ED are variable resistors, branches CD and DA are non reactive resistors of 400Ω each and branch CE is a condenser of $2\mu F$ capacitance. The supply is connected to A and C and the detector to B and E. Balance is obtained when the resistance of BC is 400Ω and ED is 500Ω. Determine the resistance and inductance of AB. Identify the bridge also. 6

(c) Describe and explain with the help of neat sketches the construction and working of megger. 8

5. *(a)* Describe the constructional details and working of a single phase electrodynamometer type of wattmeter. Derive the expression for deflection for *ac* operation if the instrument is spring controlled. 10

(b) What are the errors in energy meter and how they are compensated ? 5

(c) A single *kWhr* meter makes 500 revolutions per *kWhr*. It is found on testing as making 40 revolutions in 58·1 seconds at 5*kW* full load. Find out percentage of error. 5

6. (a) Explain the configuration with neat diagram of Crompton potentiometer and bring out its salient features. How is it standardised ? 6

(b) Calculate the inductance of a coil from the following measurement on an *a.c* potentiometer.

Voltage drop across a $0 \cdot 1\Omega$ standard resistor connected in series with the coil $= 0 \cdot 613 \angle 12°6'V$. Voltage across the test coil through a 100/1 *volt* ratio box $= 0 \cdot 781 \angle 50°48'V$. Frequency $= 50Hz$. 4

(c) Differentiate between CT and PT. Discuss the theory of PT with phasor diagram. Derive the expressions for actual transformation ratio, ratio error, and phase angle error of a PT. 10

7. Write short notes on : ***(any four)*** 4×5=20

(a) Ballastic Galvanometer

(b) Vibration Galvanometer

(c) Wein bridge

(d) High resistance measurement

(e) Rectifier type instrument.

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