53 (IE 402) ELMI

2014

ELECTRICAL MEASUREMENT & 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 out of **seven.***

1. *(a)* Describe the constructional details and principle of operation of d'Arsonval galvanometer. 5

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

(c) A moving coil mili-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 $30\times25mm^2$ and is wound with 100 turns. The flux density in the gap is $0\cdot2\,wb/m^2$. 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 $1\cdot7\times10^{-8}\,\Omega\text{-}m$. 10

2. (a) A basic d'Arsonval movement galvanometer with a full scale reading of $5\mu A$, and internal resistance of 1800Ω is available. It is to be converted into a 0-1V, 0-5V, 0-25V, 0-125V, multi-range voltmeter using individual multipliers for each range. Calculate the value of the individual multiplier. 5

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

(c) The inductance of a moving iron ammeter is given by $L = (0 \cdot 01 + C\theta)^2 mH$ where θ is the deflection from the zero position in degree. The angular deflection of the instrument corresponding to $1 \cdot 5A$ and $2A$ are respectively 90° and 120°. Find the value of C. 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 this 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

4. (a) Which bridge is used for measurement of frequency ? Explain the bridge with circuit diagram. 1+4

(b) An *a.c.* schering bridge has the following constants —

Arm *ab* → Unknown capacitor C_x and R_x in series

Arm *bc* → Resistance of $2k\Omega$

Arm *cd* → capacitor of $0{\cdot}5\mu F$ in parallel with $1k\Omega$ resistor.

Arm *da* → Capacitor of $0{\cdot}5\mu F$

Frequency → $1kHz$.

Determine the unknown capacitance and dissipation factor. 5

(c) Describe and explain with the help of neat sketches the construction and working of megger. 10

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

(b) If the reactance coil circuit of a wattmeter is 1 per cent of its resistance, calculate the error due to this cause at power factors 0·8 and 0·1 respectively. 6

(c) What are the errors in energy meter and how they are compensated ? 4

6. (a) Describe the basic principle of operation of a *d.c.* potentiometer. Explain why a potentiometer does not load the voltage source whose voltage is being measured. 4+2

(b) Draw the equivalent circuit and phasor diagram of a current transformer. Also derive the transformation ratio and phase angle. 10

(c) Differentiate between CT and PT. 4

7. Write short notes on the following : ***(any four)*** 4×5

(a) Vibration Galvanometer

(b) Earth resistance measurement

(c) Shunt type ohmmeter

(d) Rectifier type instrument

(e) Ammeter-voltmeter method

(f) Maxwel inductance bridge.
