53 (IE 402) ELMI

2012 C
2013
(May)

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.*

1. *(a)* Define the classification between "Absolute instrument" and "Secondary Instrument". Give suitable example for each case. 5

   (b) What are the different effects used in producing deflecting torque in an analog instrument ? Cite examples, in which these effects are used. 5

(c) Describe the construction and working of PMMC instrument. Explain the type of constructions used to extend the range of this type of instrument. 8

(d) What is swamping resistance ? 2

2. (a) How ammeter and voltmeter sensitivity is determined ? 4

(b) State and explain the constructional details and working principle of the two types of moving iron instrument (with neat sketch). 8

(c) A PMMC instrument has a coil resistance of 100Ω, and gives a full scale deflection (FSD) for a current of $500\mu A$. Determine the value of shunt resistance required if the instrument is to be employed on an ammeter with FSD of 5A. 5

(d) What is the need of make-before break and break-before make type switch ? 3

3. (a) Derive the torque expression for moving iron instrument. 6

(b) Discuss *two* different methods with neat sketch to measure rotational power. 8

(c) A moving coil meter with a coil resistance of 100Ω and a full scale deflection current of $100\mu A$ is to be used in the voltmeter circuit as shown in *Figure 1.* The voltmeter ranges are to be $50V$, $100V$, and $150V$. Determine the required value of resistance for each range. 6

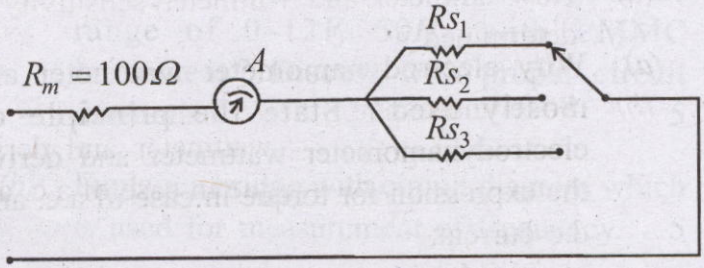

Figure : 1

4. (a) State the working principle of a dynamometer for measuring cutting force. Show a potentiometric arrangement to measure cutting force. 6

(b) Discuss the constructional details of a thermocouple type instrument used at radio-frequency current. Discuss their advantages and disadvantages. 8

(c) The working wire of a single sag hot wire instrument is $15cm$ long and is made up of pt-Ag with a co-efficient of linear expansion

16×10^{-6}. The temperature rise of the wire is $85°C$ and the sag is taken up at the center. Find the magnification — 6

(i) with no initial sag

(ii) with an initial sag of $1mm$.

5. (a) Why electrodynamometer wattmeter are mostly used ? State the principle of electrodynamometer wattmeter and derive the expression for torque in case of a.c. and d.c current. 6

(b) Discuss the wattmeter error due to different connections. 6

(c) A $250V$, $10A$ dynamometer type wattmeter has resistance of current and potential coils of 0.5 and $12{,}500\Omega$ respectively. Find the percentage error due to each of the two methods connection when unity power factor loads at $250volts$ are of

(a) $4A$, (b) $12A$

Neglect the error due to the inductance of pressure coil. 5

(d) A thermoelectric ammeter is assumed to have a perfect square law response. It gives a full scale deflection for a current of $10A$. Calculate the current which causes half scale deflection. 3

6. (a) How you can measure the a.c voltage in the range of $0–12V$, $50Hz$ with PMMC instrument ? Discuss with proper circuit diagram. 5

(b) Explain a bridge with circuit diagram which is used for measurement of frequency. 5

(c) Describe the working principle of Hay's bridge for measurement of inductance. Derive equation for balanced condition and draw the phasor diagram for same. 5

(d) The arms of an a.c. Maxwell bridge are arranged as follows :- AB and BC are non reactive resistors of 100Ω each, DA is standard variable inductor L_1 of resistance 32.7Ω and CD comprises a standard variable resistor R in series with a coil of unknown impedance. Balance was obtained with $L_1 = 47.8mH$ and $R = 1.36\Omega$. Find the resistance and inductance of the unknown coil. 5

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

(a) Ballistic Galvanometer

(b) Megger

(c) L.P.F wattmeter

(d) Schering bridge

(e) Current transformer

(f) Hydraulic absorption dynamometer

(g) Vibration Galvanometer.
