

**ELECTRICAL & ELECTRONIC MEASUREMENT  
(ELEC 2103)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which of the following is an example of an integrating instrument?  
(a) Voltmeter (b) Watt-hour meter (c) Ammeter (d) Wattmeter.
- (ii) The pointer of an indicating instrument should be  
(a) very thin and light in weight (b) very heavy in weight  
(c) weight does not matter for a pointer (d) thick and heavy in weight.
- (iii) For measurement of high voltage, which type of instrument is suitable?  
(a) PMMC instrument (b) Electrostatic instrument  
(c) Induction type instrument (d) Moving iron type instrument.
- (iv) Horizontally mounted moving iron instruments use  
(a) eddy current damping (b) fluid friction damping  
(c) electromagnetic damping (d) air friction damping.
- (v) In an electro-dynamometer type of wattmeter  
(a) the current coil is made fixed (b) the pressure coil is made fixed  
(c) any of the two coils can be made fixed (d) both the coils should be movable.
- (vi) A 1mA ammeter has a resistance of  $100\Omega$ . It is to be converted to a 1A ammeter. The value of the shunt resistance required is  
(a)  $0.001\Omega$  (b)  $0.1001\Omega$  (c)  $100000\Omega$  (d)  $100\Omega$ .
- (vii) The nominal ratio of a current transformer is  
(a) primary winding current/secondary winding current  
(b) rated primary winding current/ rated secondary winding current  
(c) number of secondary winding turns/number of primary winding turns  
(d) all of the above.
- (viii) A Megger is a  
(a) PMMC type instrument and measures low resistance  
(b) moving iron type instrument and measures low resistance  
(c) PMMC type instrument and measures high resistance  
(d) moving iron type instrument and measures high resistance.

- (ix) Inductance can be measured by using  
(a) De'Sauty bridge (b) Schering bridge (c) Hey's bridge (d) Wien bridge.
- (x) A true RMS reading voltmeter uses two thermocouples in order to  
(a) increase sensitivity  
(b) cancel out the non linear effect of first thermocouple  
(c) prevent drift in dc amplifier  
(d) all of these.

### Group - B

2. (a) Why a controlling torque is necessary in an analog indicating instrument? What will happen in the absence of a controlling torque? [(CO1) (Remember/LOCQ)]
- (b) Deduce the expression for deflection of an attraction type moving iron instrument, if it is Spring controlled and comment on the shape of its scale. [(CO1)(Analyze/IOCQ)]
- (c) In an electrodynamic instrument, the total resistance of the voltage coil circuit is  $8200\Omega$  and the mutual inductance changes uniformly from  $-173\mu\text{H}$  at zero deflection to  $+175\mu\text{H}$  at full scale, the angle of full scale being  $95^\circ$ . If a potential difference of  $100\text{V}$  is applied across the voltage circuit and a current of  $3\text{A}$  at a power factor of  $0.85$  is passed through current coil, what will be the deflection? The spring control constant is  $4.63 \times 10^{-6}\text{N-m/rad}$ . [(CO1)(Evaluate/HOCQ)]
- 3 + 5 + 4 = 12**
3. (a) What are the advantages and disadvantages of Electrostatic Instrument? Mention its suitable applications. [(CO1)(Remember/LOCQ)]
- (b) Define Absolute error and Limiting error. [(CO2)(Understand/LOCQ)]
- (c) A  $0\text{-}150$  Volt voltmeter has a guaranteed accuracy of  $1\%$  of full scale reading. The voltage measured by this instrument is  $85$  volt. Calculate the limiting error in percent. [(CO2)(Evaluate/HOCQ)]
- 5 + 4 + 3 = 12**

### Group - C

4. (a) A wattmeter is rated at  $10\text{A}$  and  $25\text{V}$ . The current coil has a resistance of  $0.06\Omega$  and a reactance of  $0.02\Omega$ . The potential coil circuit may be assumed to be purely resistive having a resistance of  $6250\Omega$ . Find the error if the wattmeter is so connected that i) the current coil is on the load side, ii) the pressure coil is on the load side. The load is  $10\text{A}$  at a power factor of  $0.174$  lagging. The voltage across the load is  $25\text{V}$ . [(CO3)(Evaluate/HOCQ)]
- (b) Derive the expression for deflecting torque in a single phase induction type energy meter. [(CO3)(Analyze/IOCQ)]
- 6 + 6 = 12**
5. (a) Draw the equivalent circuit and phasor diagram of the current transformer. [(CO4)(Understand/LOCQ)]
- (b) Derive the expression for its ratio error. [(CO4)(Analyze/IOCQ)]

- (c) What happens if the secondary side of a current transformer is opened when the primary winding is energized? [(CO4)(Evaluate/HOCQ)]  
**(2 + 4) + 4 + 2 = 12**

### Group - D

6. (a) How is Wien Bridge used to measure unknown frequency? Derive the condition for balance of the bridge and find frequency in terms of bridge parameters. [(CO5)(Analyze/IOCQ)]
- (b) An ac bridge has following constants:  
Arm AB-Capacitance of  $0.5\mu\text{F}$  in parallel with  $1\text{K}\Omega$  resistance  
Arm AD- resistance of  $2\text{k}\Omega$ .  
Arm BC- capacitance of  $0.5\mu\text{F}$ .  
Arm CD-unknown capacitor  $C_x$ ,  $R_x$  in series, Frequency  $1\text{kHz}$  given.  
Determine the unknown capacitance and dissipation factor. [(CO5)(Evaluate/HOCQ)]  
**6 + 6 = 12**
7. (a) A basic slide wire potentiometer has a working battery of 3 Volt with zero internal resistance. The resistance of slide wire is  $400\Omega$  and its length is 200cm. A 200 cm scale is placed along the slide wire. The slide wire has 1mm scale divisions. The instrument is Standardized with 1.018 V standard cell with sliding contact at the 101.8 cm mark on the Scale. Calculate  
i. working current  
ii. the resistance of series rheostat  
iii. the range of measurement. [(CO4)(Evaluate/HOCQ)]
- (b) Draw and explain the working principle of a megger. [(CO1)(Understand/LOCQ)]  
**6 + 6 = 12**

### Group - E

8. (a) Explain with diagram how a fault can be localized using Varley loop test. [(CO5)(Understand/LOCQ)]
- (b) What is the disadvantage of an average reading voltmeter over a true rms voltmeter? Why two thermocouples are used in a true rms voltmeter? [(CO6)(Analyse/IOCQ)]  
**6 + (2 + 4) = 12**
9. (a) Explain the working of dual slope integrating type DVM where voltage to time conversion has been carried out. [(CO6)(Understand/LOCQ)]
- (b) A half wave rectified sine voltage is applied to an average reading voltmeter with a scale calibrated in terms of the rms value of sine wave. Calculate the error of the meter. [(CO6)(Analyse/IOCQ)]  
**7 + 5 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	38.54	33.33	28.13

**Course Outcome (CO):**

After the completion of the course students will be able to understand the mechanism and operating principles of various deflecting type measuring instruments and extension of their ranges.

1. define and classify various errors in measurement.
2. acquire knowledge of various power and energy measuring devices .
3. understand the operating principles and applications of instrument transformers and potentiometers.
4. acquire knowledge about and analyze various ac and dc bridges for measuring different electrical parameters and their applications.
5. acquire knowledge about various electronic and digital instruments like average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, electronic multi-meter, digital voltmeters.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question