(vii) Two equal voltages of same frequency applied to the X and Y plates of a CRO, produce a circle on the screen. The phase difference between the voltages is
(a) 150°      (b) 90°      ( c) 150°      (d) 30°.

(viii) In an induction type meter maximum torque is produced when the phase angle between the two fluxes is
(a) 0°      (b) 45°      (c) 60°      (d) 90°.

(ix) Calibration of DC potentiometer is done with the help of standard cell of voltage ........ at 20oC.
(a)1.5V      (b) 1.01864V      (c) 1.001864V      (d) 1.0864V.

(x) Frequency can be measured by using
(a) Maxwell's bridge      (b) Schering bridge
(c) Hey's bridge      (d) Wien bridge.

## Group - B

2. (a) Explain the operating principle of attraction type and repulsion type moving iron instrument with proper diagrams.

(b) Derive the deflecting torque equation of an electrodynamometer instrument for ac operation.

(c) Why electrodynamometer instruments can be used both in ac and dc?

**(2+2) + 6 + 2 = 12**

3. (a) Define the terms 'Accuracy', 'Precision', 'Sensitivity' and 'Hysteresis', in the context of measurement.

(b) The inductance of a moving iron instrument is given by $L = 10 + 5\theta - \theta^2$ μH, where $\theta$ is the deflection of the pointer in radian from zero position. The spring constant is $12 X 10^{-6}$ Nm/rad. Estimate the deflection for a current of 3A.

(c) Three resistors $R_1=200\Omega\pm2\%$, $R_2=100\Omega\pm4\%$ and $R_3=50\Omega\pm5\%$ are connected in series. Find the magnitude of resultant resistance. Also find the limiting errors in percentage and in ohm.

**4 + 4 + 4 = 12**

### Group - C

4. (a) Due to the presence of pressure coil inductance in an electrodynamometer wattmeter, what error may occur in its reading? Determine the relationship between true power and actual wattmeter reading for a lagging power factor load with proper phasor diagram.

(b) A 230V, single phase induction type watt-hour meter has a constant current of 4A passing through its current coil for 6 hours at unity power factor. If the meter disc makes 2208 revolutions during this period what is the meter constant in revolutions per KWh? Calculate the power factor of the load if the number of revolutions made by the meter is 1472 when operating at 230 Volt and 5A for 4 hours.

**8 + 4 = 12**

5. (a) State the advantages of instrument transformers over shunts and multipliers in extending the range of instruments. Derive the expressions for ratio error and phase angle error in current transformer.

(b) How can ratio error of a current transformer be reduced?

(c) Why secondary side of a current transformer is never kept open circuited while primary side is energized?

**(2+3+3) + 2 + 2 = 12**

### Group - D

6. (a) Why do we prefer Kelvin double bridge to Wheatstone bridge for the measurement of low resistances? Explain the method of measuring low resistances with Kelvin double bridge, with a neat circuit diagram.

(b) An Anderson Bridge is as follows:
Arm AB: unknown inductance ($R_x$, $L_x$); Arm BC: non inductive resistance $R_2$; Arm CD: non inductive resistance $R_4$; Arm DA: non inductive resistance $R_3$; arm DE: resistance 'r'; arm EC: capacitance 'c'. A detector is connected between the terminals E and B and an ac supply is connected between the terminals and AC. Find the expressions of $R_x$ and $L_x$.
Calculate $R_x$ and $L_x$ if balance is obtained for $R_2=R_4=1000\Omega$, $R_3=500\Omega$, r=100Ω and c=3μF.

**(1+5) + 6 = 12**

7. (a) Explain the construction and working of a co-ordinate type a.c. potentiometer. How is it standardized? Explain how an unknown voltage can be measured using it.

   (b) In a Murray loop test for ground fault on a 500m long cable having resistance of 1.6Ω/km, the faulty cable is looped with a sound cable of same length and cross-section. If the resistances of ratio arms are 3:1, calculate the distance of the fault from the test end.
   **(4+2+2) + 4 = 12**

### Group - E

8. (a) Explain with the help of a circuit diagram, the principle of operation of a true RMS reading voltmeter using thermocouples. Describe why these voltmeters are free from waveform errors.

   (b) What will a true rms reading voltmeter indicate if a pulse waveform of 5V peak and duty cycle of 25% is applied to it?
   **(5+3) + 4 = 12**

9. (a) Draw the block diagram of successive approximation type digital voltmeter and describe its principle of operation.

   (b) What is the function of Delay Line in a cathode ray oscilloscope (CRO)?
   Explain how the following measurements can be made by a CRO with Lissajous patterns: i) phase angle and ii) frequency.
   **6 + 2+ (2+2) = 12**

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## ELECTRICAL & ELECTRONIC MEASUREMENT
### (ELEC 2202)

**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 alternatives for the following:      **10 x 1 = 10**

   (i) A 1mA ammeter has a resistance of 100Ω. It is to be converted to a 1A ammeter. The value of shunt resistance to be connected is
   (a) 0.001Ω    (b) 0.0999Ω    (c) 100000Ω    (d) 100Ω.

   (ii) An example of an integrating instrument is
   (a) moving coil meter      (b) moving iron meter
   (c)tangent galvanometer      (d) energy meter.

   (iii) The potentiometer is basically an instrument of
   (a) Deflection type      (b) recording type
   (c) null type      (d) integrating type.

   (iv) The burden of current transformer is expressed in terms of
   (a) secondary winding current    (b) VA rating of transformer
   (c) power factor of load      (d) none of the above.

   (v) Which bridge is preferred for measurement of inductance having high Q-factor?
   (a) Maxwell's bridge      (b) Hey's bridge
   (c) Owen's bridge      (d) De Sauty bridge.

   (vi) Murray loop is used to determine the location for
   (a) short circuit fault in a cable    (b) ground fault in a cable
   (c) open circuit fault      (d) both (a) & (b).