

B.TECH/ EE/4TH SEM/ELEC 2202/2018
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 alternative for the following: **10 × 1 = 10**
- (i) The Ac Bridge which is used for the measurement of frequency is
(a) Schering bridge (b) Wien bridge
(c) Hay's bridge (d) Anderson bridge.
 - (ii) Murray loop test can be used for locating
(a) ground fault in a cable
(b) short circuit fault in a cable
(c) both ground and short -circuit fault in a cable
(d) neither ground fault nor short -circuit fault in a cable.
 - (iii) 'Megger' is a
(a) PMMC type instrument and measures low resistance
(b) PMMC type instrument and measures high resistance
(c) moving iron type instrument and measures low resistance
(d) moving iron type instrument and measures high resistance.
 - (iv) Phantom loading for testing of energy meter is used
(a) to isolate current and potential circuit
(b) for meters having low current rating
(c) for meters having high current rating
(d) none of the above.
 - (v) 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.

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- (vi) The example of an integrating instrument is
(a) moving coil meter (b) moving iron meter
(c) tangent galvanometer (d) energy meter.
- (vii) The Maxwell's Inductance-Capacitance bridge is not suitable for the measurement of inductance of a coil if the Q factor is
(a) less than 1 (b) between 1 and 10
(c) more than 10 (d) both (a) and (c).
- (viii) 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°.
- (ix) A phase shifting transformer is used in conjunction with a
(a) dc potentiometer
(b) Drysdale potentiometer
(c) Crompton potentiometer
(d) ac co-ordinate type potentiometer.
- (x) Calibration of DC potentiometer is done with the help of standard cell of voltage ____ at 20°C
(a) 1.5V (b) 1.01864V (c) 1.001864V (d) 1.0864V.

Group - B

- 2.(a) Derive an expression for deflection of a spring controlled moving iron type instruments. Discuss its advantages and disadvantages.
- (b) The inductance of a moving iron ammeter with a full scale deflection of 90° at 1.5 A, is given by the expression $L = (200 + 40\theta - 4\theta^2 - \theta^3) \mu\text{H}$, where θ is the deflection of the pointer in radian from zero position. Estimate the angular deflection of the pointer for a current of 1.0A.
- (c) A PMMC instrument has a coil of dimension 15mm × 12mm. The flux density in the air gap is $1.8 \times 10^{-3} \text{ Wb/m}^2$ and the spring constant is $0.14 \times 10^{-6} \text{ Nm/rad}$. Determine the number of turns required to produce an angular deflection of 90° when a current of 5mA is flowing through the coil.

(3 + 2) + 4 + 3 = 12

- 3.(a) Define the terms 'Accuracy', 'Precision', 'Sensitivity' and 'Hysteresis'.
- (b) The table below shows the set of ten measurements recorded during an experiment. Calculate the precision of the fifth measurement.

Sl.No	1	2	3	4	5	6	7	8	9	10
Measured Value (in Volt)	151	150	152	151	152	153	149	151	148	152

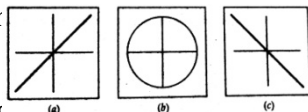
- (c) A circuit was tuned for resonance by eight different students and values of resonant frequency in KHz were recorded as 532, 548, 543, 535, 546, 531, 543 and 536. Calculate i) the arithmetic mean ii) the average deviation iii) the standard deviation and iv) probable error.

$$4 + 4 + 4 = 12$$

Group - C

4. (a) What is creeping? How it can be overcome?
- (b) Derive the torque equation for a electro dynamometer type wattmeter.
- (c) A wattmeter has a current coil of 0.003Ω resistance and a pressure coil of 6000Ω resistance. Calculate the percentage error if the wattmeter is so connected that:
- the current coil is on the load side
 - the pressure coil is on the load side

If the load takes 20 A at a voltage of 220 V and 0.6 power factor in each case, which load cur



$$3 + 4 + 5 = 12$$

- 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 of a current transformer.
- (b) Define transformation ratio, nominal ratio, turns ratio and ratio correction factor for instrument transformers.

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

Group - D

- 6.(a) Explain the method of measuring low resistances using Kelvin's double bridge.
- (b) Describe the working of Hay's bridge for measurement of inductance. Derive the equations under balance conditions and draw the phasor diagram under balance conditions. Why is this bridge suitable for measurement of inductance of high Q coils?

$$4 + (2 + 5 + 1) = 12$$

7. (a) Describe the construction and working of a Drysdale polar potentiometer. How is it standardized?
- (b) A telephone wire having a resistance of $14.6 \Omega/\text{km}$, develops a fault to earth. When looped with a sound wire of the same length, the total resistance is found to be 56Ω . If the value of the variable resistance is 16.3Ω in a Varley loop test with ratio arms equal, calculate the distance of the fault.

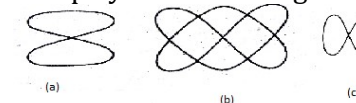
$$6 + 6 = 12$$

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 how these voltmeters are free from waveform errors.
- (b) What would a true RMS reading voltmeter indicate if a pulse waveform of 12V peak and duty cycle of 40% is applied to it?
- 9.(a) A sinusoidal input is applied to the vertical input of an oscilloscope starting at $t=0$. The following Lissajous patterns are obtained when a sinusoidal input is applied to the horizontal terminals. Estimate the phase shift between vertical and horizontal inputs.

$$(5 + 3) + 4 = 12$$

Calculate the ratio of vertical to horizontal frequencies for an oscilloscope which displays the following Lissajous figure:



- (b) Mention one DVM where voltage to frequency conversion is carried out. Explain its working principle with a proper diagram.

$$(3 + 3) + 6 = 12$$