

(Set-L)

B.Tech-5th

Electrical Measurement & Instrumentation

Full Marks : 70

Time : 3 hours

Answer any six questions including Q. No. 1
which is compulsory

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2 × 10

- (a) What is Quantisation Error in digital instruments ?
- (b) Accuracy guarantees precision but not vice versa. Explain.
- (c) What is meant by sensitivity of an instrument ?
- (d) Write two important differences between an instrument transformer and a power transformer.

(Turn Over)

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- (e) Show with a diagram how an ammeter can be used to for dual range.
 - (f) What is the difference between 'span' and 'range' of a measuring instrument ?
 - (g) LVDT is a passive sensor (True or False). Explain.
 - (h) Express 'Volt' in terms of SI fundamental units.
 - (i) What is piezoelectric effect ?
 - (j) Differentiate between dual trace and dual beam CRO.
2. (a) Derive the expression for total power in two wattmeter method of measuring three phase power. Derive the expression for load power factor. 5
- (b) A 3 phase star connected RL load consists of resistance of 16Ω and inductive reactance of 12Ω per phase. A three phase star connected supply with 230 V per phase is applied to the load. Two wattmeters $W1$ and

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W_2 are used to measure the total power. W_1 is connected between phase 'a' and 'b', while W_2 is connected between phase 'c' and 'b'. What is the power indicated by the instruments ? 5

3. (a) Draw the phasor diagram and derive the expression for ratio and phase errors in potential transformers. 5

(b) A 100/5A, 50 Hz current transformer has a bar primary and a rated secondary burden of 12.5 VA. The secondary winding has 196 turns and a leakage inductance of 0.96 mH. With a purely resistive burden at rated full load, the magnetisation mmf is 16 A and the loss excitation requires 12 A. Find the ratio and phase errors. 5

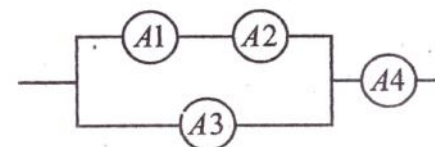
4. (a) Describe the principle and working of Thermocouple. 5

(b) A platinum resistance sensor is used to interpolate between the triple point of water (0°C), the boiling point of water

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(100°C) and the freezing point of zinc (419.6°C). The corresponding resistance values are $100.0\ \Omega$, $138.5\ \Omega$ and $253.7\ \Omega$. The algebraic form of the interpolation equation is : $R_T = R_0(1 + \alpha T + \beta T^2)$; where $R_T\ \Omega$ = resistance at $T^\circ\text{C}$. $R_0\ \Omega$ = resistance at 0°C . α, β = constants. Find the numerical form of the interpolation equation. 5

5. (a) To measure a load current of 10 A, four similar ammeters (A_1, A_2, A_3, A_4) rated (0 – 20 A) are used. The resistance of the ammeters is negligible when compared to the load. If the meter connections are as shown below. What are the reading of the meters. 5



- (b) In order to measure the direct current in wire, a 5 A meter is connected in series with it and indicated 4.0 A. When the 5 A meter is replaced by a 10 A meter, the reading is

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4.2 A. Both meters are known to be accurate and each produces full-scale deflection for 50 mV instrument drop. What is the value of the current in the wire when neither meter is in the circuit ?

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6. (a) Derive an expression for vertical deflection of an electron beam in a CRT.

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(b) For a CRT, the anode voltage is 2 kV and Y deflection plates 2 cm long and 5 mm apart. The screen is 30 cm from the centre of the plates. Find the maximum velocity of beam of electrons. Find the deflection sensitivity. If 20 V (RMS) sinusoidal input voltage is applied, what is total length in y direction swept by the electron beam.

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7. (a) Derive the equations for balancing in the case of Maxwell's inductance-capacitance bridge. Draw the phasor diagram for balanced condition.

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(b) A bridge has the following constants : arm AB , $R = 800 \Omega$ in parallel with $C = 0.159 \mu\text{F}$; $R = 1000 \Omega$; CD , $R = 500 \Omega$;

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DA , $C = 0.636 \mu\text{F}$ in series with an unknown resistance. Find the frequency for which the bridge is in balance and the value of resistance in DA to produce balance.

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8. Write short notes on any two :

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(i) Wagner Earthing Device

(ii) PMMC Instrument

(iii) Energy Meter.