PRINCIPLES OF INSTRUMENTATION

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer question No.1 and any *six* from the rest.

1. (a) Choose the most appropriate answer :

    $1 \times 5 = 5$

    (i) Which of the following devices cannot
    be used for measurement of temperature ?

    (a) RTD

    (b) Thermocouple

    (c) LVDT

    (d) Pyrometer.

    (ii) Dynamic response consists of :

    (a) two parts, one steady state and the
    other transient state response.

(b) only transient state response

(c) only steady state response

(d) steady state and transient frequency response.

(iii) XY recorders

    (a) record one quantity with respect to another quantity

    (b) record one quantity on x-axis with respect to time on y-axis

    (c) record one quantity on y-axis with respect to time on x-axis

    (d) None of the above.

(iv) A thermometer reads 95.45°C and the static correction given in the correction curve is −0.08°C. The true value of temperature is

    (a) − 95.37°C

    (b) 95.37°C

    (c) − 4.55°C

    (d) 4.55°C

(v) A quantity whose magnitude has a definite repeating time cycle is called a

(a) transient

(b) transient state periodic

(c) steady state aperiodic

(d) steady state periodic.

(b) Fill in the blanks :   1×5=5

(i) .... is defined as the ratio of change in output signal to the change in input signal.

(ii) For a critically damping system, the value of damping ratio is ....

(iii) Parabolic input represents an input signal which is proportional to the .... and therefore represents a constant acceleration.

(iv) The LED is a .... device which emits light when a current passes through it in the forward direction.

(v) .... is defined as the largest change in the input quantity to which the measuring system does not respond.

2. (a) Briefly describe the zero order system with suitable example. 5

(b) A 10,000Ω variable resistance has a linearity of 0.1% and the movement of contact arm is 320°C.

(i) Determine the maximum position deviation in degrees and the resistance deviation in ohm.

(ii) If this instrument is to be used as a potentiometer with a linear scale of 0 to 1.6V, determine the maximum voltage error. 5

3. (a) Define the following terms and find expressions for them. $2 \times 3 = 6$

(i) Rise time

(ii) Peak time

(iii) Settling time.

(b) A linear second order with single degree of freedom system has a mass of 8×10^{-3} kg and stiffness of 1000 N/m.

(i) Calculate the natural frequency of the system.

(ii) Determine the damping constant necessary to just prevent overshoot in response to a step input of force.   4

4. (a) Derive the equation for time response of a first order system when subjected to unit step input. Also draw the response curve.   5

   (b) The dead zone in a certain pyrometer is 0.125% of span. The calibration is 400°C to 1000°C. What temperature change might occur before it is detected?   5

5. (a) What are the differences between LCD and LED technology?   5

   (b) What is an XY recorder? Explain. Mention some applications of XY recorder.   5

6. (a) Explain the theory and working of LCDs. Describe the differences between light scattering and field effect types of LCDs.   6

   (b) Give a comparison between LCD and Plasma technology.   4

7. (a) A moving coil voltmeter has a uniform scale with 100 divisions. The full scale reading is 200V and 1/10 of a scale division can be estimated with a fair degree of certainty. Determine the resolution of the instrument in volt.   4

(b) Define the following terms : 2×3=6

(i) Under damped system

(ii) Random error

(iii) Precision.

8. (a) What are the different standard inputs for studying the dynamic response of a system ? Define and sketch them. 8

(b) Define the terms : 2

(i) Grounding

(ii) Shielding.

9. Write short notes on : 2×5=10

(a) Static characteristics

(b) Digital display devices.

10. (a) Derive the second order equation relating the input and output of a seismic transducer.

8

(b) Define the term 'transfer function'. 2