Total No. of printed pages = 8

RETEST EXAMINATION - 2019

Semester : 5th

Subject Code : CAI -503

PRINCIPLES OF INSTRUMENTATION

Full Marks – 70

Time – Three hours

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

Instructions :

1. *All* questions of PART – A are compulsory.
2. Answer any *five* questions from PART – B.

PART – A

Marks – 25

1. Fill in the blanks : 1×10 =10

   (a) The ratio of the change in output to the change in input is the ———— of the instrument.

   (b) A spurious signal that modifies the output of the instrument is termed as ————.

[Turn over

(c) A thermocouple transduces the temperature signal in the form of ————.

(d) The largest change of input quantity for which the instrument does not respond is ————.

(e) The algebraic difference between the upper and lower range values is termed as ———— of the instrument.

(f) ———— is defined as the time required by a measurement system to begin to respond to a change in the measurand.

(g) The input impedance of an instrument should be ————.

(h) The rapidity with which the measurement system responds to the changes in the measured quantity is called as ————.

(i) The limits of deviations from the specified value are defined as ————.

(j) The act or result of quantitative comparison between a known standard and the output of the measuring system measuring the same quantity is called as ————.

2. Write true or false : 1×5=5

(a) Precision is a measure of the degree of agreement within a group of measurements.

(b) The incapability of an instrument to faithfully measure, record, or control the input signal in undistorted form is called Systematic Error.

(c) The time taken to reach 63.2% of the input value in a first order system subjected to step input is time constant.

(d) The output impedance of a device should be high.

(e) Linear potentiometer is an example of first order system.

3. Determine the input and output variable for the following transducers : 1×3=3

(a) RTD

(b) Bourdon Tube

(c) LVDT

4. Name the units of following process variables : 1×4=4

(a) Temperature

(b) Pressure

(c) Flow rate

(d) Level

5. Choose the correct answer : 1×3=3

(a) A 0 to 300V voltmeter has an error of ± 2% of full scale deflection. What would be the range of the readings when true voltage is 30V ?

(i) 24V to 36V

(ii) 29.4V to 30.6V

(iii) 20V to 40V

(iv) None of the above

(b) The voltage of a circuit is measured by a voltmeter having an input impedance comparable with the output impedance of the circuit thereby causing error in voltage measurement. This error may be called

(i) Gross error

(ii) Random error

(iii) Error caused by misuse of instrument

(iv) Error caused by loading effect

(c) Which of the following is a dynamic characteristic ?

(i) Speed of response

(ii) Static sensitivity

(iii) Drift

(iv) Dead Band.

PART – B

Marks – 45

6. (a) Define the following terms : 1×6=6

(i) Input impedance

(ii) Output impedance

(iii) Speed of response

(iv) Measuring Lag

(v) Fidelity

(vi) Dynamic error

(b) The resistance of an unknown resistor is determined by Wheatstone bridge by the following relation :

$$R_1 = \frac{R_2 R_3}{R_4}$$

The limiting values of resistances are $R_2 = 330\ \Omega \pm 3\%$, $R_3 = 440\Omega \pm 2\%$ and $R_4 = 500\Omega \pm 5\%$.

Determine :

(i) the nominal value of unknown resistance.

(ii) the limiting error of the unknown resistor in ohm. 3

7. (a) Describe the important elements of a measurement system. 6

(b) Define limiting and relative limiting errors. Write the expressions. 3

8. (a) Describe the different errors in measurements with suitable examples. 5

(b) Describe the physics of device operation of an LED. 4

9. (a) Describe the methods that are used to eliminate interferences in a measurement system. 5

(b) Using a suitable diagram, explain the working of seven segments display. 4

10. Write short notes on the following : 3×3=9

(i) Potentiometer type recorder

(ii) X-Y Recorder

(iii) Data loggers.

11. (a) Name the different versions of printers. Explain each of them. 6

(b) What do you mean by overdamped, critically damped and underdamped systems ? 3

12. Derive expressions for the first order systems subjected to the following input : 3×3=9

(i) Impulse input

(ii) Unit input

(iii) Ramp input

13. (a) Define transfer function of a system. 2

(b) What do you mean by order of a system ? 2

(c) Name the standard signals used in time domain analysis. Describe each of them with relevant diagrams and mathematical expressions. 5

14. (a) Describe the mathematical models of mechanical translational and rotational systems with suitable expressions. 6

(b) Describe the classification of Digital Display units. 3