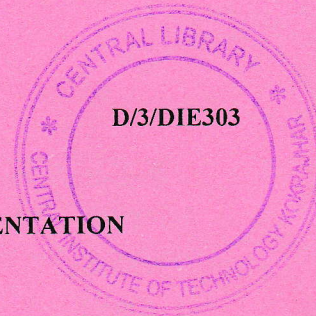


Total number of printed pages:3



2021

FUNDAMENTALS OF INSTRUMENTATION

Full Marks: 100

Time: Three hours

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

Answer any five questions.

1. a) Define the terms: Measurand and Instrument of the measurement system. 2
- b) Explain primary and secondary standards of measurement. 4
- c) Explain any three classification of instrument. 6
- d) Explain the elements of a measurement system with the help of an example. 8
2. a) Define the terms: Linearity and Dead Zone of an instrument. 4
- b) A force transducer measures a range of 0- 400N with a resolution of 0.25 percent of full scale. What is the smallest change which can be measured by this transducer? Determine span of the transducer. 4
- c) Define the terms: Sensitivity, Range, Threshold and Resolution of an instrument. 6
- d) A pressure transducer is calibrated at a temperature of 30°C and has the Pressure -Voltage characteristic as shown in Table1. 6

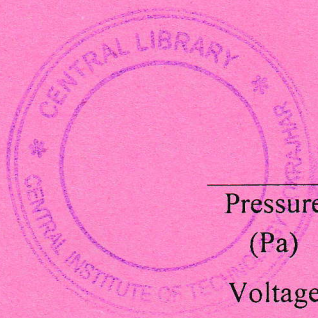


Table1

Pressure (Pa)	0	1	2	3
Voltage (mV)	0	200	400	600

The same transducer is used at a temperature of 40°C and obtained the Pressure – Voltage characteristic of it as shown in Table2.

Table2

Pressure (Pa)	0	1	2	3
Voltage (mV)	0	200	400	600

Determine the following of the transducer (i) Sensitivity at 30°C (ii) Sensitivity at 40°C (iii) Sensitivity drift (iv) Zero drift (v) Zero drift and Sensitivity drift per °C change in ambient temperature.

3. a) The calibration range of a load cell is 40N to 90N. If the dead zone of it is 0.11 percent of span, determine span and dead zone of the load cell. 5
- b) Specify the differences of static and dynamic characteristic of an instrument. Draw an input used for finding the dynamic characteristic of an instrument. 5
- c) Derive the input-output relation for a first order instrument. Draw its dynamic response. 10
4. a) With a neat diagram, explain X-Y recorder. 8
- b) Derive the input-output relation for a second order 12

instrument. Draw its dynamic response.

5. a) Three resistors have the following ratings: $R_1 = 37 \Omega \pm 5\%$, $R_2 = 75 \Omega \pm 5\%$ and $R_3 = 50 \Omega \pm 5\%$. Determine the magnitude and limiting error in ohm and in percent of the resistance connected in series 5
- b) The unknown resistance of a wheat-stone bridge is given as $R_X = \frac{(R_2 R_3)}{R_1}$; where $R_1 = 100 \pm 0.5\% \Omega$, $R_2 = 1000 \pm 0.5\% \Omega$, $R_3 = 842 \pm 0.5\% \Omega$. Determine the magnitude of the unknown resistance and the limiting error in percent and in ohm for the unknown resistance; R_X . 5
- c) Define error. Explain types of error. 10
6. a) With a neat diagram, explain strip chart recorder. 6
- b) Define the terms: Drift, Zero drift and Sensitivity drift of an instrument. Specify the factors that contribute towards the drift in the instruments. 6
- c) Ten students tuned the circuit for resonance and the values of resonant frequency in KHz were recorded as: 412, 428, 423, 415, 426, 411, 423, 416, 417 and 420. Calculate arithmetic mean and standard deviation of the recorded resonant frequency. 8
7. a) With the help of diagrams, explain any three methods for measuring displacement. 10
- b) With the help of diagrams, explain any three methods for measuring temperature. 10

