Total No. of printed pages = 4

19/3rd Sem/DIE303

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) Specify the standards of measurement. 3

   (b) With the help of a block diagram, explain the functional elements of a measurement system. 7

   (c) Define an instrument and also explain its classification. 10

2. (a) Explain static characteristics of an instrument. 9

   (b) The calibration range of a bourdon tube pressure gauge is 0 to 90N/m^2. If the dead zone of it is 0.11 per cent of span, determine span and dead zone of the bourdon tube pressure gauge. 4

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(c) A thermometer measures a range of 0-100°C with a resolution of 0.5 per cent of full scale. What is the smallest change which can be measured by thermometer ? Determine span of the thermometer. 4

(d) The Force-Voltage characteristic of load cell is shown in Table1. Determine the sensitivity of the load cell. 3

Table 1

Force (N)	0	5	10	15	20
Voltage (mV)	0	100	200	300	400

3. Derive the input-output relation for the following and also draw its dynamic response :

(a) Second order instrument. 12

(b) Zero order instrument. 8

4. (a) Explain error and its types. 10

(b) Define recorder. Explain X-Y recorder. 10

5. (a) Two resistors; $R_1 = (450 \pm 5)\ \Omega$ and $R_2 = (500 \pm 3)\ \Omega$ are connected in series. What is the equivalent resistance ? 4

(b) The voltage across a wire is (100 ± 5) V and the current passing through it is (10 ± 0.2) A. Determine (i) The magnitude of the wire resistance (ii) The magnitude and limiting error of the wire resistance. 6

(c) A dynamometer is used to measure the output power of a rotating shaft. The output power is given as $P = \frac{(2\pi \times 9.81FLR)}{t \times 10^6}$; where $F = 4.26 \pm 0.02$ kg, $L = 382 \pm 1.2$ mm, $R = 1192 \pm 1.0$ revolutions, $t = 60 + 0.50$s. Determine (i) The magnitude of power (ii) The magnitude of the limiting error in the computed power. 10

6. (a) By using a load cell the following readings were taken of a certain force : 1.34, 1.38, 1.56, 1.47, 1.42, 1.44, 1.53, 1.48, 1.40 and 1.59 N. Calculate (i) Arithmetic mean (ii) Deviations. 8

(b) The voltage (mV) in a circuit was recorded as : 49.7, 50.1, 50.2, 49.5 and 49.7 by different people. Calculate arithmetic mean, average deviation, standard deviation and variance of the recorded voltage. 12

7. With the help of diagram, explain any *one* method for measuring the following : 5×4=20

(a) Level

(b) Pressure

(c) Temperature

(d) Displacement.