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Courses » Industrial Instrumentation

Announcements

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Mentor

Unit 2 - Week 1

Course outline

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Week-1 Assignment on Static and Dynamic Characteristics

1) 1 point

A temperature sensor can measure in the range 0 to 400 °C. Worst-case deviation from the best-fit straight line is found to be 5 °C. Find out the maximum non-linearity as a percentage of full-scale.

- 1) 1.0
- 2) 1.25
- 3) 1.5
- 4) None of these

Accepted Answers:

2) 1.25

2) 2 points

Find out the maximum hysteresis as a percentage of full-scale deflection (f.s.d) from the following readings of a pressure sensor.

True pressure (psi)	0	20	40	60	80	100	80	60	40	20	0
Gauge pressure (psi)	0	18	35	55	77	98	82	59	43	22	0

- 1) 5 %
- 2) 6 %
- 3) 7 %
- 4) 8 %

Accepted Answers:

4) 8 %

3) 2 points

Assume, thermoelectric voltage versus temperature relationship of a thermocouple is given by, $e(t) = a_1 t + a_2 t^2 + a_3 t^3$. With the reference junction at 0°C, thermo-emf at 100°C is 33 μV, thermo-emf at 500°C is 1.24 mV and thermo-emf at 1000°C is 4.83 mV. Find a_1 , a_2 , a_3 .

- 1) $a_1 = -0.245 \mu\text{V}/^\circ\text{C}$; $a_2 = +0.005825 \mu\text{V}/^\circ\text{C}$; $a_3 = -7.5 \times 10^{-7} \mu\text{V}/^\circ\text{C}$
- 2) $a_1 = 0.245 \mu\text{V}/^\circ\text{C}$; $a_2 = 0.005825 \mu\text{V}/^\circ\text{C}$; $a_3 = -7.5 \times 10^{-7} \mu\text{V}/^\circ\text{C}$
- 3) $a_1 = 0.245 \mu\text{V}/^\circ\text{C}$; $a_2 = +0.005825 \mu\text{V}/^\circ\text{C}$; $a_3 = 7.5 \times 10^{-7} \mu\text{V}/^\circ\text{C}$
- 4) $a_1 = -0.245 \mu\text{V}/^\circ\text{C}$; $a_2 = -0.005825 \mu\text{V}/^\circ\text{C}$; $a_3 = -7.5 \times 10^{-7} \mu\text{V}/^\circ\text{C}$

Accepted Answers:

1) $a_1 = -0.245 \mu\text{V}/^\circ\text{C}$; $a_2 = +0.005825 \mu\text{V}/^\circ\text{C}$; $a_3 = -7.5 \times 10^{-7} \mu\text{V}/^\circ\text{C}$

4)

2 points

A sensor has an input – output relationship as $y = 4x^2$. Find its maximum static sensitivity in the range $0 \leq x \leq 100$.

- 1) 400 unit
- 2) 600 unit
- 3) 800 unit
- 4) None of these

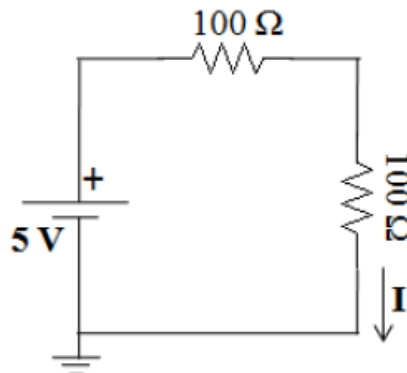
Accepted Answers:

3) 800 unit

5)

2 points

Calculate the percentage error in measurement of I , when I is measured by inserting an ammeter of internal resistance $R_m = 1 \Omega$ suitably.



(Ignore the sign of error)

- 1) 0.5 %
- 2) 5 %
- 3) 1 %
- 4) 1.5 %

Accepted Answers:

1) 0.5 %

6)

2 points

A first order instrument measures sinusoidal signals with frequency content up to 200 Hz with a dynamic error of 2 %. What is the allowable time-constant?

- 1) 0.162 second
- 2) 0.162 millisecond
- 3) 1.62 millisecond
- 4) 16.2 millisecond

Accepted Answers:

2) 0.162 millisecond

7)

2 points

A first order temperature furnace is heating at the rate of $50^{\circ}\text{C}/\text{min}$. The time-constant of the system is 15 second. Find out,

- (i) Steady-state error in the system.
(ii) Steady-state time lag of the system.

(Ignore the sign of error)

- 1) (i) 12.5°C ; (ii) 0
 2) (i) 12.5°C ; (ii) 15 second
 3) (i) 7.5°C ; (ii) 15 second
 4) (i) 7.5°C ; (ii) 0

Accepted Answers:2) (i) 12.5°C ; (ii) 15 second

8)

2 points

A first-order pressure sensor is suddenly subjected to 10 Pascal pressure. The sensor shows 6 Pascal after 2 second. Calculate the error after 3 second in sensor reading.

(Ignore the sign of error)

- 1) 25.3 %
 2) 23.5 %
 3) 26.5 %
 4) 21.3 %

Accepted Answers:

1) 25.3 %

9)

1 point

A first-order system is subjected to a unit step-change in input. The time-constant of the instrument is 1 second. Find out the time-instant when error is maximum.

- 1) Insufficient data
 2) at 1 second
 3) at 0.707 second
 4) None of these

Accepted Answers:

4) None of these

10)

1 point

A sinusoidal signal is measured with a first-order instrument having time-constant of 5 ms. Find, the highest frequency of input signal that can be measured, if maximum tolerable dynamic error is $\pm 2\%$.

- 1) 40.6 Hz
 2) 6.46 Hz
 3) 10.64 Hz
 4) 45.64 Hz

Accepted Answers:

2) 6.46 Hz

11)

5 points

An accelerometer that is 2nd order in nature is to be selected to measure sinusoidal signal of frequency below 200 Hz. If dynamic error of $\pm 6\%$ is allowed, find the natural frequency (ω_n) of the sensor for damping ratio 0.7.

- 1) 12752 rad/sec
- 2) 1275.2 rad/sec
- 3) 2029.5 rad/sec
- 4) 1014.7 rad/sec

Accepted Answers:

3) 2029.5 rad/sec

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