01 Solution QP code:- 39330

T.E Chemical, Sem - VI CBSGS.

Subject :- Instrumentation

Q.No.1 b

Given

1. Stepper motor turns 10° per step.
2. Rotational speed = 250 rpm

$= \frac{250}{60}$ rps

$= 4.167$ rps.

3. Input pulse rate per second is to be found out.

Solution

No. of steps per revolution $= \frac{360}{10}$

$= 36$ steps/revolution

$\therefore$ Input pulse rate $= 36 \times 4.167$

$= 150.012$ steps/second

Q.NO.2 a

Given

1. A platinum - 100 RTD sensor.
2. $R_0 = 100\,\Omega$ [Resistance at $0^\circ c$]
3. $R_T = 139.1\,\Omega$ [Resistance at $T = 100^\circ c$]
4. $R_T = ?$ [Resistance at $T = 50^\circ c$]
5. $T = ?$ [When $R_T = 110\,\Omega$]

Solution

(02)

We know that →

$$R_T = R_0[1+\alpha T]$$

$$\therefore 139.1 = 100[1+\alpha \times 100]$$

$$\therefore 1+\alpha 100 = \frac{139.1}{100}$$

$$\therefore 1+100\alpha = \sout{0.1391}$$

$$\therefore 1+100\alpha = 1.391$$

$$\therefore 100\alpha = 1.391 - 1$$

$$\therefore 100\alpha = 0.391$$

$$\therefore \alpha = \frac{0.391}{100} = 3.91\times10^{-3}$$

Again –

$$R_T = R_0(1+\alpha T]$$

$$\therefore R_T = 100[1+3.91\times10^{-3}\times50]$$

$$\therefore R_T = 119.55\ \Omega$$

Again –

$$R_T = R_0[1+\alpha T]$$

$$\therefore 110 = 100[1+3.91\times10^{-3}\times T]$$

$$\therefore \frac{110}{100} = 1+3.91\times10^{-3}T.$$

$$\therefore T = 25.57^0C.$$

Hence –

1. Resistance at $50^0C = 119.55\ \Omega$
2. ~~Resistance~~ Temperature when $R = 110\ \Omega$ is 25.57^0C.

Q.No.3 b (03)

Given

1. A temperature sensor measures temperature from 40°C to 250°C.

   Hence span = 250 − 40 = 210°C

2. Measured value = 130°C

3. Error to be calculated when

   i. Accuracy is ± 0.5 % of full scale

   ii. Accuracy is ± 0.6 % of the span.

Solution

i. Full Scale value is 250°C

$$\text{Hence accuracy} = \pm \frac{0.5}{100} \times 250$$

$$= \pm 1.25\,^\circ C$$

Now − True value is 130 ± 1.25

⇒ 131.25 or 128.75

Now −

$$\%\ \text{error} = \frac{\text{True Value} - \text{Measure Value}}{\text{True Value}} \times 100$$

$$= \frac{131.25 - 130}{131.25} \times 100 \quad \text{OR} \quad \frac{128.75 - 130}{128.75}$$

= 0.95 OR −0.95

= ± 0.95 %

ii Span is 210 °C (04)

Hence accuracy $= \pm \frac{0.6}{100} \times 210$

$= \pm 1.26\,°C.$

Hence True value $= 130 + 1.26 = 131.26\,°C$

OR

$= 130 - 1.26 = 128.74\,°C$

Now –

$$\% \text{ Error} = \frac{TV - MV}{TV} \times 100$$

Hence –

$$\% \text{ Error} = \frac{131.26 - 130}{131.26} \times 100$$

$$= 0.96\,\%$$

or

$$\% \text{ Erro} = \frac{128.74 - 130}{128.74} \times 100$$

$$= 0.97$$

Hence error $= \pm 0.96\,\%$

Q.NO.4 b

Given

1. $\rho = 1000\,kg/m^3$
2. $h_1 = 0.02\,m$
3. $h_2 = 0.1\,m$

Solution

We know that –

(05) $P_1 = h_1 \rho g$

$= 0.02 \times 1000 \times 9.81$

$= 196.2 \ N/m^3$

& $P_2 = h_2 \rho g$

$= 0.1 \times 1000 \times 9.81$

$= 981 \ N/m^2$

Gauge pressure $= P_1 + \text{atm. pressure}$

$= 196.2 + 1.013 \times 10^5$

$= 101496.2 \ N/m^2$

Gauge pressure $= P_2 + \text{atm. pressure}$

$= 981 + 1.013 \times 10^5$

$= 102281 \ N/m^2$

Q.No.5c

Given

~~Voltage sensitivity = 0.055 v/m Pa~~

~~2. Potential difference = 11 V~~

~~3. Pressure in bar to be found out~~

3. Thickness = 5cm.

Solution

Q.NO.5 c

06

1. A wheatstone bridge is given
2. $R_1 = 200\Omega$
3. $R_2 = 2000\Omega$
4. $R_3 = 1500 + 25T$, T is temperature
5. The temperature range is 0 to 100°C
6. The range of R_3 has to be found out

Solution

We know that $R_m = \frac{R_2}{R_1} \times R_3$

$$\therefore R_3 = \frac{R_1}{R_2} \times R_m$$

Since, $R_m = 1500 + 25T$

at $T = 0°C$, $R_m = 1500 + 25 \times 0 = 1500\Omega$

Hence –

$$R_3 = \frac{200}{2000} \times 1500 = 150\Omega$$

at $T = 100°C$, $R_m = 1500 + 25 \times 100$

$= 1500 + 2500$

$= 4000\Omega$

Hence – $R_3 = \frac{200}{2000} \times 4000$

$= 400\Omega$

Hence R_3 ranges from 150Ω to 400Ω