53 (IT 701) ININ

2017

INDUSTRIAL INSTRUMENTATION

Paper : IE 701

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions* out of ***eight***.

1. *(a)* What are load cells? Describe a Magneto-Elastic load cell and a strain gauge type load cell. How do they differ in operation aspects? 10

   (b) A motor shaft is running at 1500*rpm* and delivering shaft power of 6 Horsepower. Calculate the torque developed by a motor shaft. 4

   (c) Explain the construction and working of Stroboscope with neat diagram. 6

Contd.

2. *(a)* Explain the construction, operation and derive the transfer function for Null-Balance (servo)–Type Accelerators ? 12

(b) Calculate the voltage output of a Quartz piezoelectric crystal having a thickness of $3mm$ and a voltage sensitivity of $0{\cdot}07\,V.m/N$ is subjected to a pressure of $30kg/cm^2$. 2

(c) Explain the working principle of Thermal Conductivity Density Gauges. 6

3. *(a)* Convert $0{\cdot}1\ kg/cm^2$ into *(i)* $mmWG$ *(ii)* $mmHg$ and *(iii)* bar units. 3

(b) In the McLoad gauge used for measuring vacuum following readings are taken for two vacuum pressure P_1 and P_2.

$P_1 = 10^{-3} torr$ (known) and the corresponding $h_1 = 300mm$.

For unknown P_2 the reading $h_2 = 40mm$. Find out the pressure P_2. 3

(c) What is the theory of operation of Dead-weight tester ? What precautions should be observed while calibrating with Dead-weight tester ? 8

(d) Explain about a hot Cathode Ionisation gauge. 6

4. (a) We have to calibrate a differential pressure transmitter using hydrostatic pressure principle to measure level of a tank. Calculate the calibrated range of the transmitter for various installation A_1 & B_1. 10

Transmitter	SG of liquid in the tank	Low (0%)	High (100%)	Calibration range
at 0 level	1·10	0*mm*	1000*mm*	
at –500 level	1·10	20*mm*	1000*mm*	

B_1= The level Transmitter is connected at one end which is the zero level and the other end is connected whose impulse tapping is 1300*mm* above the datum zero lead. The liquid in this impulse line is 1·05. The pressure in the tank is 3 *bar*. The liquid in the tank has SG=1·10

Transmitter	SG of liquid in the tank	Low (0%)	High (100%)	Calibration range
at 0 level	1·10	200*mm*	1000*mm*	
at 100 level	1·10	100*mm*	1000mm	

(b) Describe about Saybolt Viscometer and Eddycurrent Drage-Cup Tachometer. 10

5. (a) What are the RTD lead wire compensation techniques ? Explain *any one* with neat sketch. 6

(b) Explain the characteristics of Nickel, Copper and Platinum type RTDs. 4

(c) Explain the factors affecting the RTD performance and elaborate on

(i) Self heating

(ii) Sensor response time

(iii) Hysteresis &

(iv) RTD Stability-Drift. 10

6. (a) Describe with neat sketches the principle of operation of — (i) an orifice plate (or) (ii) venturi tube 6

(b) What are the different types of direct and indirect methods of liquid level measurement ? Explain with neat sketch in each one of the methods. 14

7. (a) Discuss on the characteristics and features of *K* Type Chromel-Alumel Thermocouple. 5

(b) Explain about the Cold Junction in thermocouple and the use of Extension wire for thermocouple measurement. 5

(c) Explain the importance of Stefan Boltzmann law and field of view distance relationship, defying the inverse square law. Write the mathematical relationship between view angle and distance ratio and explain. 10

8. Write the short notes on the following with neat diagram : 4×5=20

(i) Total radiation pyrometer

(ii) Bimetallic Thermometer

(iii) Bourdon tube pressure gauge

(iv) Hair hygrometer.