**53 (IE 701) ININ**

**2014**

# INDUSTIRAL 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)* Define Gauge Factor for strain gauge and what are the advantages of a Semi conductor stain gauge ? 6

*(b)* Explain the working principle of stain gauge in Torque measurement. 5

*(c)* What is Proximity Sensor, its types and explain *any one* with neat sketch ? 6

(d) It was observed under test that a piece of brass $75cm$ long and with a cross sectional area of $1{\cdot}5\,cm^2$ was elongated to $0{\cdot}075\,cm$. What was the Force applied to sample ? (Young's Modulus 'E' for brass may be assumed as $9{\cdot}66\times10^5\,kg/cm^2$). 3

2. (a) Explain briefly about Seismic Acceleration Pickups (Accelerometer) working principle, relative displacement expression and its analysis in the steady state condition. 10

(b) What are the different methods of vibration pickups and how acceleration calibration by laser interferometer ? 10

3. (a) What are the Mechanical balances for Force Measurement and Derive the Expression for analytical balance used for Measuring unknown force ? 10

(b) What will be *(i)* Gauge pressure at the depth of 45 *Meters* in a water tank ? Express them in $kg/cm^2$ and in *mmHg*. 4

(c) Design a pressure sensor with Primary and Secondary Transducer and explain its working principle. 6

4. Write short note on the following : ***(any four)*** 4×5=20

*(a)* Sling Psychrometer

*(b)* Electrical absorption Hygrometer

*(c)* Capacitive level sensor

*(d)* Hydrostatic level sensor

*(e)* Bi-metallic strip thermometer

*(f)* Bridge type gas densitometer

5. *(a)* Convert $2500°F$ to degree centigrade, Degree Kelvin and Degree Rankine. 3

*(b)* In a two-wire RTD installation using PE 100 RTD, if the lead wire resistance per leg is $7 ohms$, calculate *(i)* the contribution of lead wire resistance to the measurement error. *(ii)* if the actual temperature is $250°C$, what is the percentage of error ? (Assume the temperature Coefficient as $0{\cdot}385$ *ohm/°C* For Pt 100 RTD). 3

*(c)* Distinguish between RTD and Thermistor ? 6

(d) What is meant by Cold-Junction Compensation ? Of what practical importance is it ? How may it be obtained ? 8

6. (a) What are the uses of radiation pyrometer, Black body radiation and its emissivity ? 10

(b) A total radiation pyrometer is used to measure a furnace refractory wall temperature. The Fumes and Smoke along the path absorbs at 7% of radiant heat energy. If the pyrometer reads $1400\,^{\circ}C$, what will be the actual wall temperature ? 3

(c) What are the different types of optical pyrometers and discuss about two-colour pyrometer ? 7

7. (a) Define the term Flow and explain the operation of Electromagnetic Flowmeter. 10

(b) Distinguish between Head Flow Meters and Area Flow Meter (types). 4

(c) Explain the construction and operation of Pressductor. 6

8. *(a)* Determine the displaced volume of the liquid at $20°C$ when the buoyancy effect on the object is $7000kg$. (hint : liquid density $\simeq$ water density). 2

*(b)* A capacitance probe with a $8\,PF/m$ characteristic is used in a level application. The bridge component values for a particular application are : 4

$C_2 = 120$ Micro Farad ;

$R_1 = 12K\Omega$

$R_2 = 140K\Omega$

$R_3 = 60K\Omega$ .

Find the level on the probe.

*(c)* Water is pumped through a $95mm$ diameter pipe with a Flow Velocity of $820\,mm/sec$. Find the volume Flow rate and Mass Flow rate. 4

*(d)* Explain the construction and operation of Dead weight tester ? 5

(e) Consider a Mechanical System for seismic instrument as in *Fig :1*. If the mass $(m)$ and spring constant $(k)$ are as below, calculate (a). The natural frequency $(\omega_n)$ of the system and (b) the critical damping coefficient $(C_c)$. During initial transient calculate (c) the frequency of the motion $(\omega)$ and (d) The Phase angle $(\phi)$. Assume $C/C_c = 0{\cdot}09$ and $\omega_1/\omega_n = 3{\cdot}5$. 5

$m = 0{\cdot}0065\, kg$

$k = 550\ N/m$

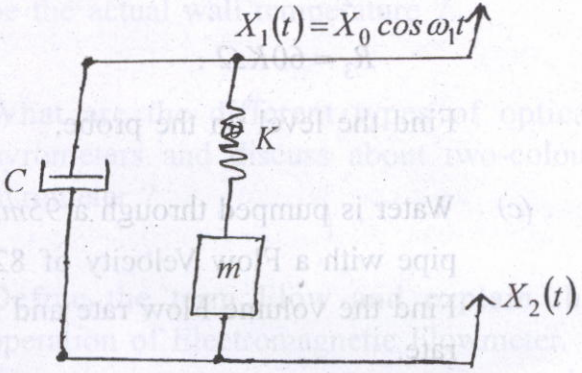


*Fig : 1*

*Mechanical System For a Seismic Instrument*