

Q.P code: 27381

Q.1
A) What is base metal & rare metal thermocouples & state their advantages & disadvantages. (4)

Ans →

- * Base metal t/c: These are made by the combination of pure metal and alloys of iron, copper and nickel. Mostly used to measuring lower ranges of temp. up to 1375°C
- * Rare metal t/c: These are made by the combination of pure metal & alloys of
 - (a) platinum and rhodium for temp up to 1725°C
 - (b) tungsten, rhodium and molybdenum for temp up to 2625°C
- * Advantages / Disadvantages of
Enlist two advantages & disadvantages of Base & Rare metal t/c

B) The dead zone in a certain pyrometer is 0.125 percent of span. The calibration is 400°C to 1000°C . What temp change might occur before it is detected? (4)

Ans →

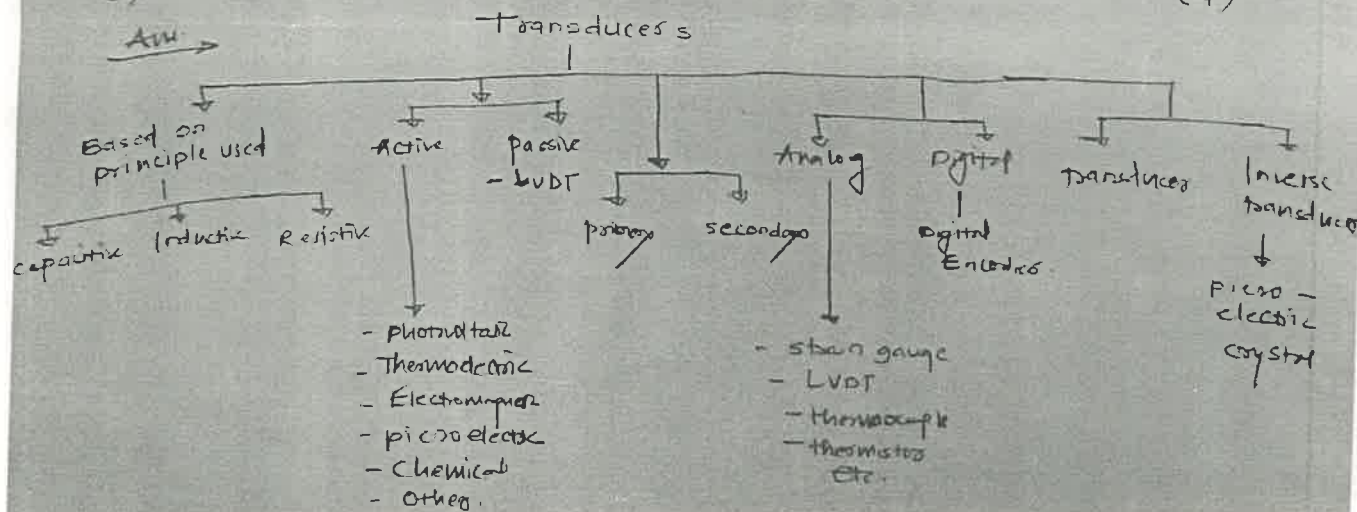
$$\text{span} = 1000 - 400 = 600^{\circ}\text{C}$$

$$\text{Dead zone} = \frac{0.125}{100} \times 600 = 0.75^{\circ}$$

A change of 0.75°C must occur before it is detected.

C) Classify transducers with suitable examples. (4)

Ans →



classification with some suitable examples.

D) Explain absolute humidity & relative humidity. (4)

Ans. → * Absolute humidity: It is defined as

The ratio of the mass of water vapour to the mass of dry air in a given volume of the mixture & is denoted by W .

Humidity Ratio = $\frac{\text{Mass of Water Vapour}}{\text{mass of dry air}}$.

* Relative humidity:

denoted by RH or ϕ

Relative humidity (At a given temp)

= $\frac{\text{Water vapour actually present}}{\text{Water vapour required for saturation}}$

E) Explain liquid level measurement using float & LVDT. (4)

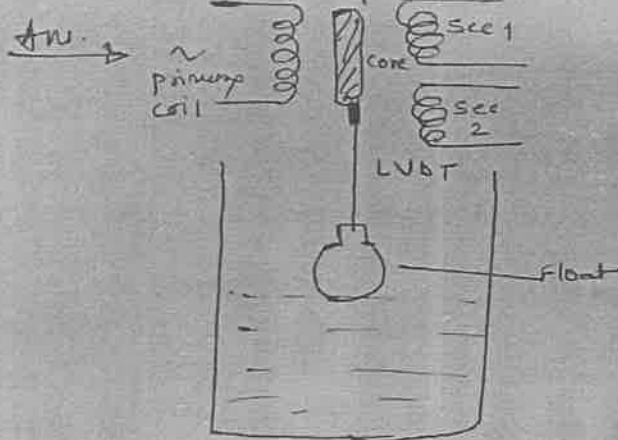


Figure with proper explanation of float & LVDT for liquid level measurement

Q. 2

(10)

★)

Types of Errors:

- i) Gross Errors
- ii) Systematic Errors
- iii) Random Errors

(i) **Gross Errors:** occur human mistakes in reading instrument and recording and calculating measurement results.

E.g. - Give one example

Remedies: - try time or even more readings should be taken
- Care should be taken in reading & recording data.

(ii) **Systematic Errors:**

(a) Instrumental Errors

due to lubricant shortcoming or
misuse
loading effect

(b) Environmental Errors

surrounding conditions
temp, humidity, dust, vibration etc

(c) Observational Errors

parallax errors

Remedies:

(iii) **Random (Residual) Errors:**

Errors remain even after the systematic errors have been taken care of. Also called Residual Error

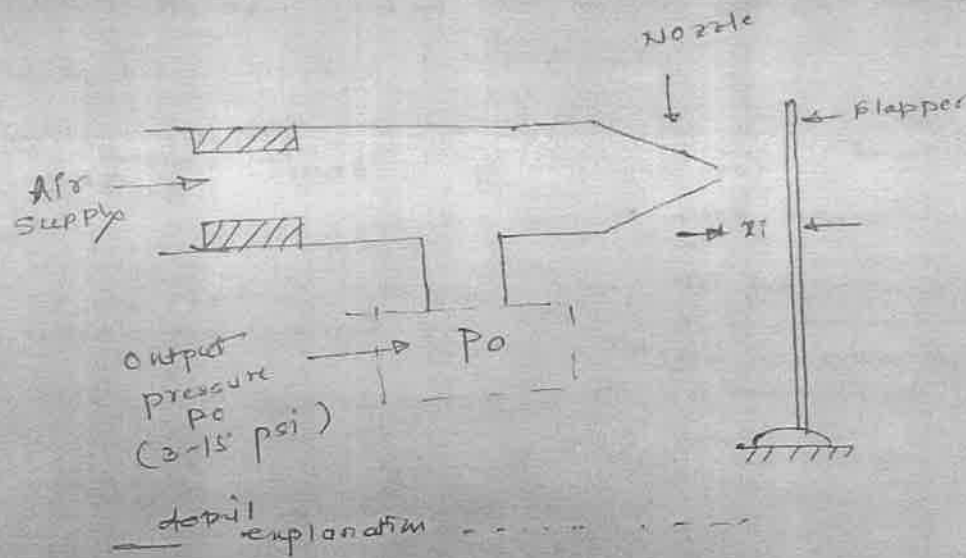
- explanation -

Remedies

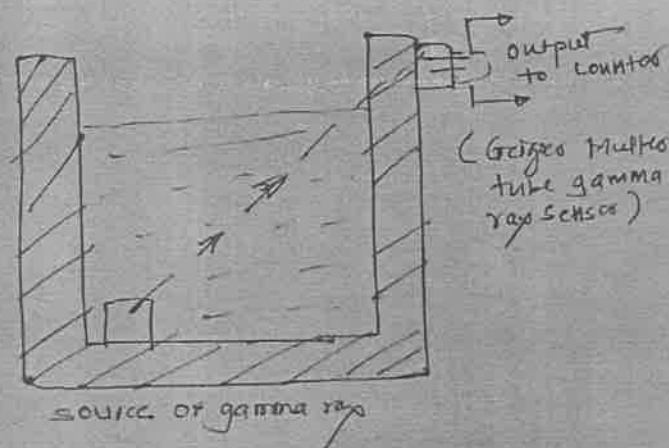
Q 2 B) Flapper - Nozzle System.

(10)

Ans → A pneumatic control system operated with air, the signal is transmitted in the form of variable air-pressure (Often in the range 3-15 psi, i.e. 0.2 to 1.0 bar) that initiates the control. One of the basic building blocks of a pneumatic control system is the flapper nozzle. It converts very small displacement signal (in order of microns) to variation in air pressure.



Q 3 A) Radioactive type level detector.



Detail explanation - - - - -

Appⁿ: - Useful for sophisticated equipment
- Useful when it is required to operate from a longer distance.

Q.3
B)

(10)

Ans →

C_1 & C_2 - capacitance, before and after the applⁿ of pressure.

d_1 & d_2 - distn betn the diaphragms

$$C_1 = \epsilon A / d_1 \quad \& \quad C_2 = \epsilon A / d_2$$

$$\frac{C_2}{C_1} = \frac{d_1}{d_2} \quad \therefore C_2 = C_1 \times \frac{d_1}{d_2}$$

but $d_1 = 3.5 \text{ mm}$ & $d_2 = 3.5 - 0.6 = 2.9 \text{ mm}$

The value of capacitance after applⁿ of pressure

$$C_2 = \frac{370 \times 3.5}{2.9} = \underline{\underline{446.5 \text{ pF}}}$$

Q.4

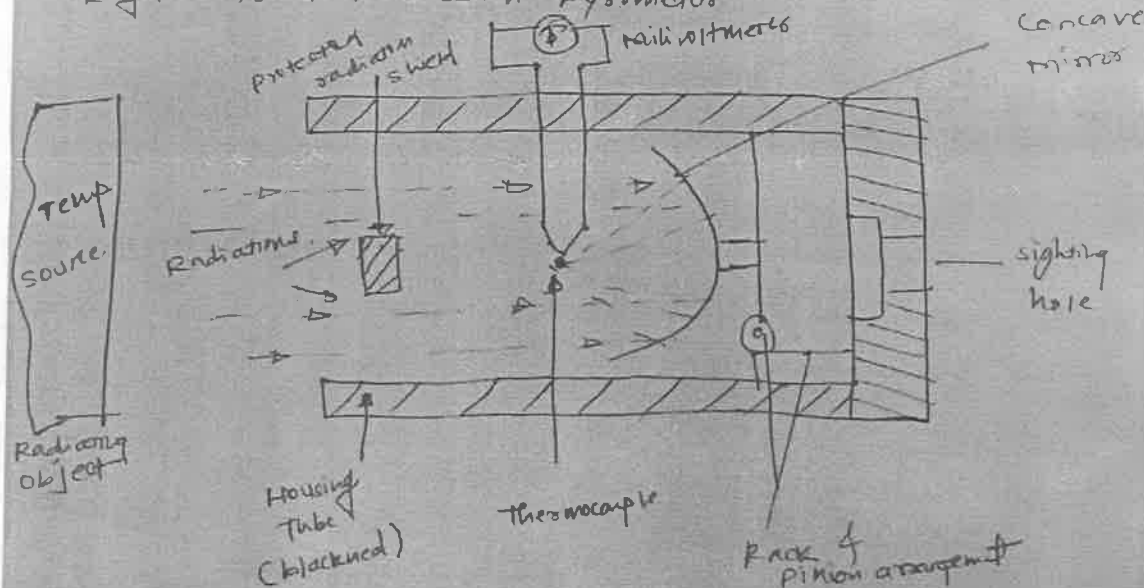
A)

Types of Pyrometers

(10)

- Total radiation pyrometer
- Optical pyrometers or disappearing filament pyrometers or monochromatic brightness radiation thermometers.
- Infrared pyrometers.

E.g: Total Radiation Pyrometer



- details explanation of any type pyrometer with diagram.

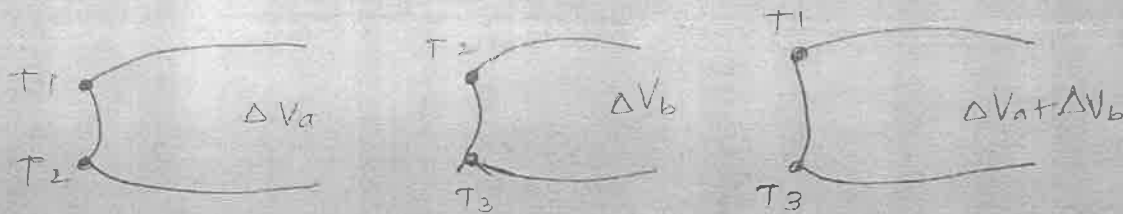
Q.4

(10)

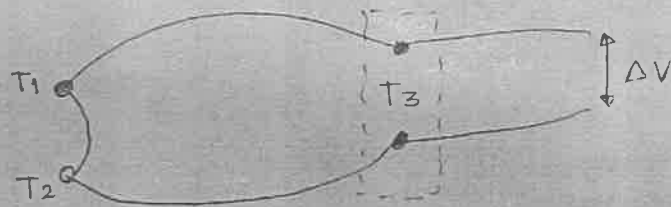
B)

* Law of Intermediate Temperature (Successive)

- If a thermocouple produces a voltage ΔV_a for junction temp T_1 & T_2 and
- If the same thermocouple produces a voltage ΔV_b for junction temp T_2 & T_3 then
- The thermocouple will produce a voltage $\Delta V_a + \Delta V_b$ for junction temp T_1 & T_3 .



* Law of Intermediate Metal:



The insertion of an intermediate material into a thermocouple circuit will not affect the emf voltage output as long as the two new junctions are at the same temp.

Q.5
1)

(10)

Construction & Working of LVDT

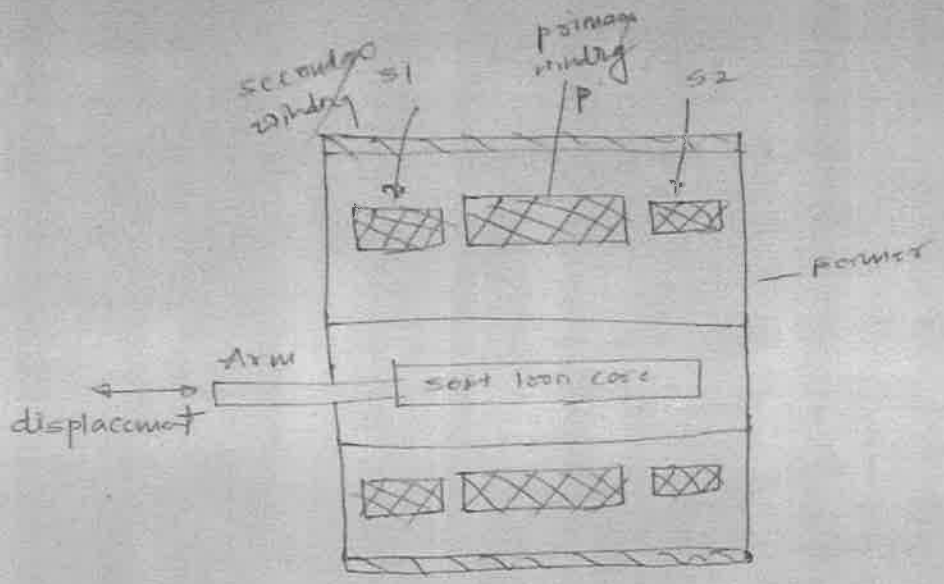


Fig. LVDT

Detail explanation: - - - - -

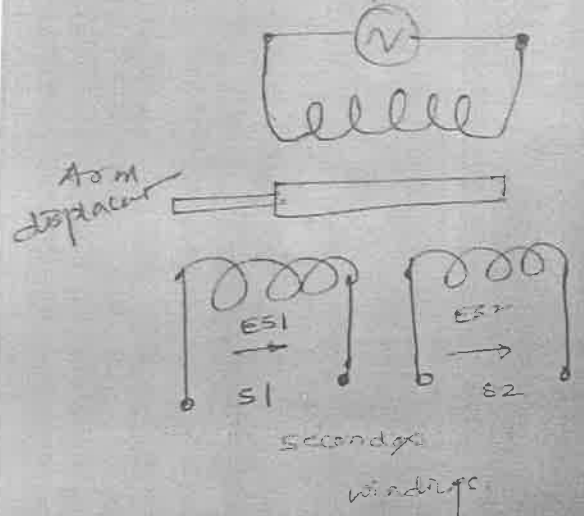


Fig: CKT diag of LVDT

Q.5
B)

(10)

The resistance of potentiometer at its normal position = $10000 \Omega = 10000 \Omega$

The resistance of pot per unit length = $10000/50 = 200 \Omega/\text{mm}$

(i) change of resistance from its normal position = $10000 - 8850 = 1150 \Omega$

displacement of wiper from its normal position = $1150/200 = 5.75 \text{ mm}$

(ii) change of resistance from its normal position = $7500 - 5000 = 2500 \Omega$

displacement = $2500/200 = 12.5 \text{ mm}$

Resolution = min^m measurable resistance \times mm/ Ω
 = $10 \times 1/200 = 0.05 \text{ mm}$

Q.6

Ans: two

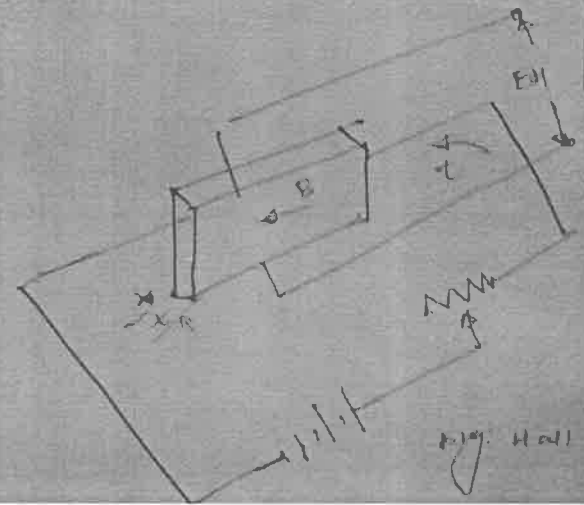
(10)

A) Hall Effect transducers — (10)

— When an electric field & magnetic field are applied perpendicular to the two faces of the material a voltage will be generated on the other surface, which is E_H to E₀.

$$E_H = K_H (IB)/t$$

E_H = potential generated
 I = in ampere
 B = in gauss
 t = in centimeters
 K_H = proportionality const / Hall coefficient (with centimeters)



P.6

e) Sound Pressure Level (SPL) Meter (10)

- A SPL meter is used for acoustic (sound that travel through air) measurement.
- Hand held instrument with a microphone
- The diaphragm of microphone responds to changes in air pressure caused by sound waves. This movement of diaphragm, i.e. the sound pressure deviation (Pascal Pa), is converted into an electrical signal (mV).

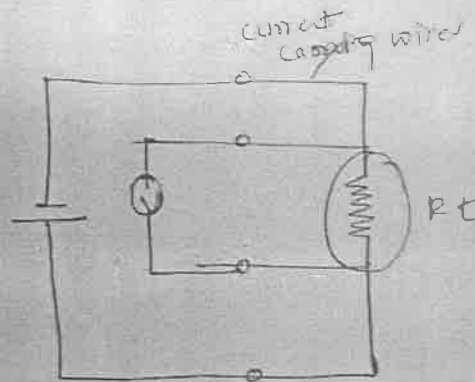
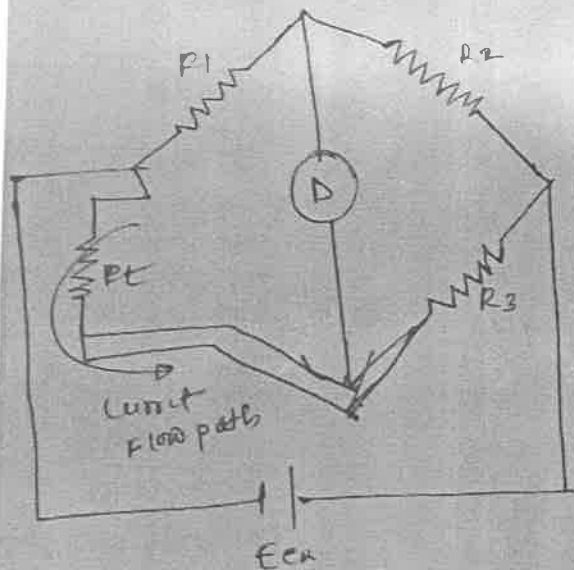
* Measurement ---
* Type of lead --- } detail explanation

c) Lead wire compensation. (10)

→ To prevent the effect of lead resistance.

(a) Three wire method

(b) Four-wire method



- Detail explanation of any one method is required.

