GOVERNMENT POLYTECHNIC COLLEGE BHILWARA

I MID TERM: 28TH November 2017

II- Year Electronics- EL-203 **Maximum Marks: 15**

All Questions are compulsory/ सभी प्रश्न अनिवार्य हैं

1. What is measurement? Explain the different characteristics of a measuring instrument? [2 marks]
2. Draw the block diagram of a measurement system. Explain the blocks used in the diagram [3 marks]
3. What is Accuracy and explain the different types of accuracy. Also explain Precision. [3 marks]
4. Define **Any 2** of the following term : [3 marks]
   a. Linearity
   b. Sensitivity
   c. Resolution
   d. Hysteresis
   e. Drift
5. Explain **Any 1** of the transducers: [4 marks]
   a. LVDT
   b. RTD
   c. Thermister

SOLUTIONS

1st Year Mid Term (EL-203) (28/11/2017)

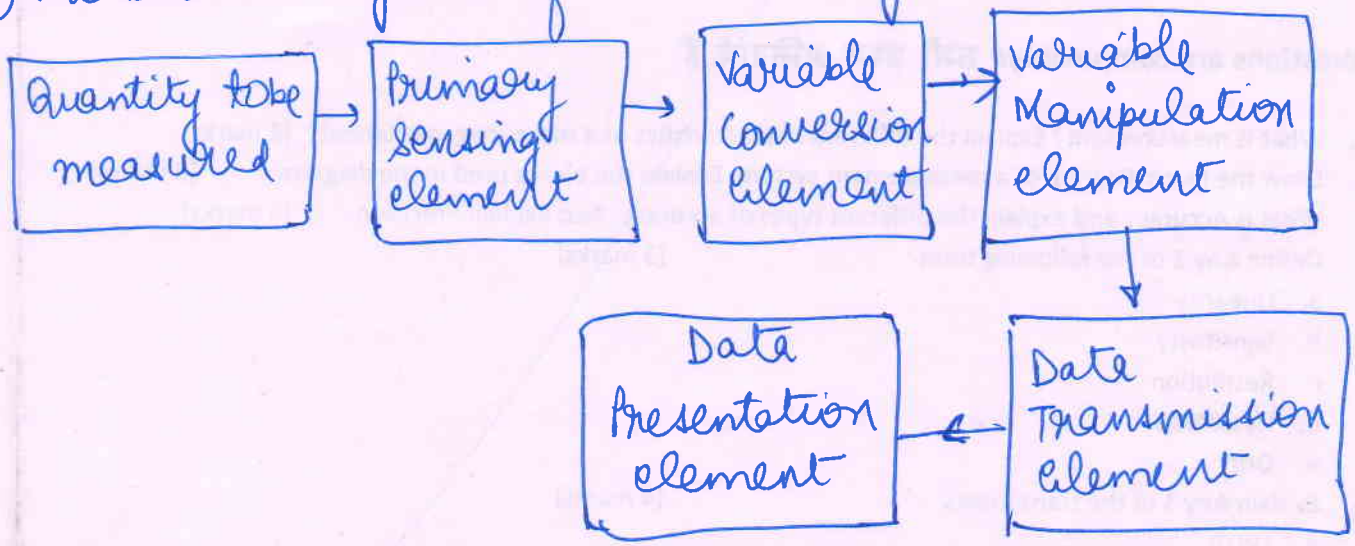
(1) Measurement is the process of comparison of an unknown quantity in terms of a standard quantity resulting in knowing the value of the unknown in terms of the standard.

The different characteristics of a measuring instrument are:

(i) The introduction of the instrument into the circuit should not alter the ambient conditions of the circuit

(ii) The power consumed by the instrument for its operation should be negligible

(2) The block diagram of a measuring instrument is.



~~Quantity to be measured~~

Primary sensing element This stage is in direct contact with the quantity to be measured

This stage element generally includes transducers and sensors. eg. LVDT, Thermistor

Variable conversion element: This stage converts the signal from one form to another.

eg: V to I, I to V

Variable Manipulation element: This element modifies the signal to a suitable form of transmission

eg: Attenuator, Amplifier, demodulator

Data Transmission element: This element transmits the signal from the process to the control room

eg optical fibre, coaxial cable

Data Presentation element: This stage is used for presenting the data in a suitable format

eg: CRO, plotters, recorders, etc.

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(3) Accuracy is the closeness with which the instrument reading approaches the true value of the quantity to be measured.

→ The accuracy can be specified either in terms of inaccuracy or in terms of limits of error and can be expressed in the following way:

→ (i) Point accuracy

→ This is the accuracy of the instrument only at one point on its scale

→ The specification of this accuracy does not give any information about the accuracy at other points on the scale.

(ii) Accuracy as "Percentage of scale range"

When an instrument has uniform scale, its accuracy may be specified in terms of scale range

(iii) Accuracy as "Percentage of true value"

→ This is the best method of specifying accuracy of an instrument

→ In this case as the readings get smaller so do the errors.

Precision

→ It is the measure of reproducibility of ~~measurement~~ measurement, i.e given a fixed value of a quantity, precision is a measure of the degree of closeness or agreement within a group of measurements.

→ It indicates consistency in the reading of the instrument

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(4) (a) Linearity

→ The linearity is defined in terms of independent linearity

→ The computation of independent linearity is done with reference to a straight line showing the relationship between output and input

→ The straight line is drawn by using the method of least squares from the given calibration data.

→ The linearity is defined as the maximum deviation of any of the calibration points from the straight line

(b) Sensitivity

It is defined as the ratio of the change in the magnitude of the output quantity to the change in magnitude of input quantity

$$S = \frac{\Delta x_o}{\Delta x_i}$$

(c) Resolution

It is defined as the smallest increment in the input which can be measured with certainity by an instrument.

→ So the resolution defines the smallest measurable input change.

$$\text{Resolution} = \frac{\Delta x_i}{\Delta x_o}$$

(d) Hysteresis

→ It is a phenomena which depicts different output effects when loading and unloading whether it is a mechanical system or an electrical system

→ It is the non-coincidence of loading and unloading curves

(e) Drift

It is the deviation of output of an instrument from desired value for particular input.

(5) RTD (Resistance Thermometer)

→ It works on the principle of change in resistance of a conductor due to change in temperature

→ The variation of resistance R with temperature T can be represented as:

$$R_T = R_0(1 + \alpha_1 T + \alpha_2 T^2 + \alpha_3 T^3 + \dots)$$

where R_0 = Resistance at temperature = 0K

Neglecting higher powers

$$R_T = R_0(1 + \alpha_1 T)$$

If reference temperature is other than 0K

$$R_{T_2} = R_{T_1}(1 + \alpha \Delta T)$$

where $\Delta T = T_2 - T_1$

Requirements of conductor

(1) Change in resistance per unit change in temperature should be as large as possible

(2) The material should have high value of resistivity

(3) The resistance should have continuous and stable relationship with temperature.