Tutorial Sheet No-3

Measurement Science & Techniques (UES034)

**Q1** The dead zone of a certain pyrometer is 0.125% of span. The range of the instrument is from 800oC to 1800oC. What temperature change must before it is detected?

**Q2** A potentiometer requires a change of 5mm to produce a change in voltage of 0.5V. Determine the sensitivity of the instrument. Also determine the deflection factor.

**Q3** A voltmeter has a uniform scale with 1000 divisions. The full scale reading is 500V and 1/20 of a scale division can be estimated with a fair degree of certainty. Determine the resolution of the instrument.

* If the instrument input is changed very gradually from zero, there will be some minimum value below which no output change can be detected. This minimum value defines the **threshold** of the instrument.
* Dead time is the time required by the measurement system to begin to respond to a change in the measurand.
* Dead zone is defined as the largest change of input quantity for which there is no output of the instrument.
* The smallest increment in input which can be detected with certainty by an instrument is its resolution or discrimination of the instrument. So resolution defines the smallest measurable input change while the threshold defines the smallest measurable input.

**Q4** Draw the response of a first order system subjected to a unit step input and find out the steady state error.

**Q5** For a ramp input find out the value of steady state error.

Q6 A wattmeter having a range 1000W has an error of ±1% of full scale deflection. If the true power is 100W, what would be the range of readings?

What would be the range of readings , if error is specified as percentage of true value?

**Q7** The temperature of a furnace is increasing at a rate of 0.10C/Sec. What is the time constant of the instrument if it is a first order with a maximum value of error is 50C.

**Q8** The solution for the unknown resistance for a wheatstone bridge is:

Rx=(R2R3)/R1

Determine the magnitude of the unknown resistance and limiting error in % and in ohm for the unknown resistance Rx. Assume resistances and limiting error by your own.

Sol.7 A=0.1

Error=A\*time constant

Therefore, time constant=5/0.1=50s

Sol1. Span=1800-800=1000°C

Dead zone=(0.125/100)X1000=1.25°C

Sol2. Sensitivity=Output/Input=0.5V/5mm=0.0001V/m

Deflection factor=1/Sensitivity

Sol.3 1 scale division=500/1000=0.5V

Resolution=1/20 scale division=1/20X0.5=0.025V

Sol6. When error is specified as percentage of f.s.d =±1%of 1000=±10W

Range of readings=90-110W

When error is specified as percentage of true value=±1%of 100=±1W

Range of readings=99-101W

Solution8:

Let R1=100±0.5%Ω

R2=1000±0.5%Ω

R3=842±0.5%Ω

Rx=(R2R3)/R1

1000\*842/100=8420Ω

Relative limiting error of unknown resistance is ±(0.5+0.5+0.5)=±1.5%

Limiting error in ohm=±(1.5/100)\*8420=±126.3Ω

Guaranteed values of resistance are between: 8420-126.3=8293.7Ω and 8420+126.3= 8546.3Ω