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Q1) Answer the following questions:

- ✓ As the time constant of the first order system increases, its response becomes faster.
- ✓ For a potentiometer, the nonlinearity increases as the (R_p/R_m) increases.
- ✓ Loading error in the potentiometer circuit causes the voltage output to be greater than the theoretical voltage value.
- ✓ Threshold is the time needed by the instrument to begin to respond to a change in input value.
- ✓ Misreading and arithmetic calculation errors are classified as catastrophic errors.
- ✓ As the specific heat of the manometer fluid increases its sensitivity increases..
- ✓ If a system is found to be precise, then it gives highly accurate values.
- ✓ Inspection is the process of quantitative comparison between a predetermined standard and an unknown magnitude.

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A wire strain gauge has gauge factor = 2 and is bonded on a steel bar subjected to stress 100 MN/m^2 . The bar has modulus of elasticity 200 GN/m^2 . The percentage change in the resistance (neglecting piezo-resistive effect) is equal to 0.1 %

$\epsilon = 5 \times 10^{-4}$

20

20% of full scale

A Barium Titanate pickup has dimension of $4\text{mm} \times 4\text{mm} \times 1.2\text{mm}$. The force acting on it is 7.5 N . The charge sensitivity of Barium Titanate is 125 pC/N and its permittivity is $12.5 \times 10^{-9}\text{ F/m}$. If the modulus of elasticity is $15 \times 10^6\text{ N/m}^2$, ϵ_c $\epsilon_{0.91}$
 Answer the following sentences:

- ① What is the name of this device?
- ② What is its main operating principle?
- ③ What is the value of strain produced by this force?
- ④ What is the value of charge produced by this device?
- ⑤ How much is its capacitance.
- ⑥ How much will be its voltage output.
- ⑦ How much will be the uncertainty in its voltage and capacitance if the uncertainty in permittivity is $1.875 \times 10^{-10}\text{ F/m}$, uncertainty in force is 2% and that for charge sensitivity is 1% .

$$w \epsilon_c = 1\%$$

$$w \phi = 2\%$$

The volume of the thermometer bulb is 1000mm^3 . It has time constant of 300s . It is desired to reduce the time constant to 100s by changing ONLY the dimensions of the bulb. The new volume of the bulb should be :

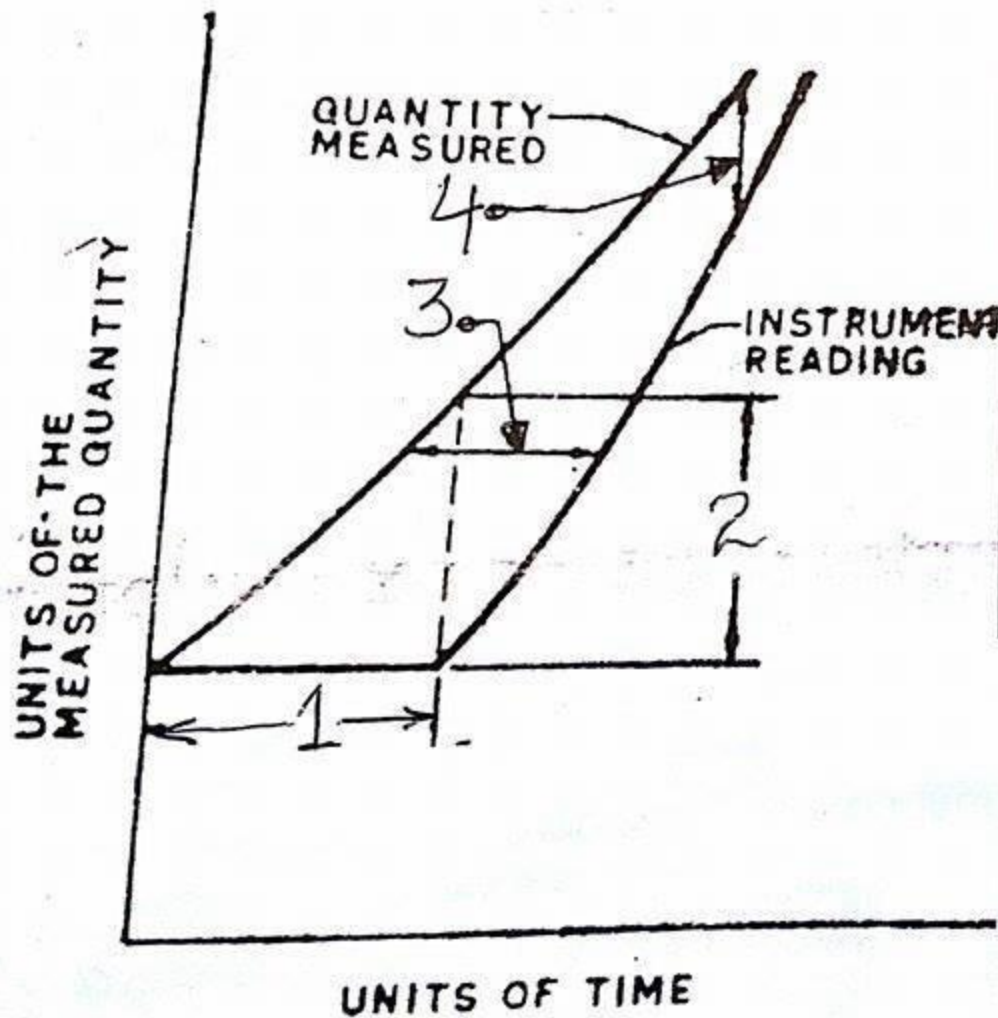
37mm^3

333.3mm^3

10mm^3

~~577mm^3~~

None



No.	Name
1	Dead time
2	Dead zone
3	Hysteresis error
4	Dynamic error

values.

- ✓ Inspection is the process of quantitative comparison between a predetermined standard and an unknown magnitude.



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$\epsilon = \frac{\Delta R}{R} = \frac{2 \times 100}{200} = 0.001$
A pressure gauge having a range 1000 kN/m^2 has an error of $\pm 2\%$ of full scale deflection. If the true pressure is 150 kN/m^2 , the range of readings will be $(980 \rightarrow 1020) \text{ kN/m}^2$. If the error is specified as percentage of true value, the range of the readings will be $(130.005 \dots 170.005) \text{ kN/m}^2$

A capacitive transducer is constructed of two $6.5 \times 10^{-4} \text{ m}^2$ plates separated by a distance of 1.0 mm in air with relative permittivity of 1.006 and permittivity of free space of $8.85 \times 10^{-12} \text{ F/m}$. The displacement sensitivity of this transducer will be equal to 1.15×10^{-5}

A first order system has time constant of 20 s . It is subjected to step input. The settling time of the output is assumed to be the time it reaches 95% of its final steady state value. The settling time is said to be equal to :

100s

60s

20s

Infinity

None

Mid-Term Exam, FIRST SEMESTER 2012-2013

Dr. Jehad A. A. Yamin

Date: 2nd December, 2012

Time: 90 minutes.

Name : Univ No. : ..0094353.....

Question (1) must be submitted in 30 minutes.

ONLY after submission of Q(1) you can start with other questions.

Q(1) Fill in the bracket with correct word.

(10 Points)

1. It is the part of metrology that deals with problems common to all metrological fields irrespective of the quantity to be measured. *General Metro.*
2. It means checking the dimensions of the produced or under-process piece to compare it with the specified dimensional accuracy. *Inspection*
3. It is the process of quantitative comparison between a predetermined standard and an unknown magnitude. *measurement*
4. Those types of measurement instruments that are commonly applied to experimental or developmental work, like Thermometer.
5. In this method of measurement, the comparison is done with a standard through use of calibrated system. *in-direct*
6. A type of output in which the instrument continuously writes, with pen and ink, the value of the measured quantity against some other variable or against time. *recording*
7. This is defined as any signal that does not convey useful information.
8. Those are the errors that should not occur, however, may be corrected and eliminated by more careful work and attention. *Controllable errors*
9. It is defined as the departure of the observed reading from the arithmetic mean of the group of readings. *deviation*
10. It tells how tightly the data are clustered around the average value. *standard deviation*
11. A thermometer has a time constant of 2.5s. It is quickly taken from a temperature 15°C to water bath at 100°C. The temperature indicated after 5.5s will be equal to 90.58°C if this thermometer starts from zero, the difference between the new and previous value will be 1.66

12. A step input of 100 kPa is applied to pressure gauge, the pointer swings to a maximum pressure of 102.5 kPa and then comes to rest at 101.3 kPa. The percent overshoot as fraction of final reading is equal to 1.1846%.
13. Two resistors $(250 \pm 2.1)\Omega$ and $(100 \pm 2.1)\Omega$ are connected in series. The limiting error of the resultant connection is $\pm 4.2 \Omega$.
14. A mass-spring system with single degree of freedom has mass = 8×10^{-3} kg and spring stiffness of 1000 N/m. This system has natural frequency equals to 353.55 rad/s $d_1 = 50.1$, $L_1 = 251$
15. The volume of a circular rod is determined by measuring its diameter and length. The diameter is $(50 \pm 0.2\%)$ mm while the length was $(250 \pm 0.5\%)$ mm. The percentage error in volume is 0.8943%. $V = \frac{\pi}{4} d^2 \cdot L$
 $V_{\text{error}} = 4.90873.8521$

Answer Q(1) Here ONLY

Q. No.	Answer	Q. No.	Answer
1	General Metrology	9	deviation
2	Inspection	10	standard deviation
3	measurment	11	$90.58^\circ\text{C} / 1.66^\circ\text{C}$
4	Detect	12	1.1846%
5	in-direct	13	$\pm 4.2 \Omega$
6	recording	14	353.55 rad/sec
7	analogue	15	0.8943% X
8	Controllable errors	Marks	12
		15	