

**The University of JORDAN**  
**FACULTY OF ENGINEERING & TECHNOLOGY**  
**DEPARTMENT OF MECHANICAL ENGINEERING**  
**ENGINEERING MEASUREMENTS (0904424)**  
**First Semester Exam, Summer Semester 2013-14**

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Paper (1) : Answer on the same question paper. (Maximum Time is 25 minutes)

**Q1) Fill in the bracket with correct word.****(3 Marks)**

1. A thermometer has a time constant of 2.5s. It is quickly taken from a temperature  $15^{\circ}\text{C}$  to water bath at  $100^{\circ}\text{C}$ . The temperature indicated after 5.5s will be equal to ~~100.195~~  $100.195^{\circ}\text{C}$  if this thermometer starts from zero, the difference between the new and previous value will be ~~1.662~~  $1.662^{\circ}\text{C}$ .

2. The volume of a circular rod is determined by measuring its diameter and length. The diameter is  $(50+0.2\%)$ mm while the length was  $(250-0.5\%)$ mm. The percentage error in volume is ~~-0.10195%~~.

3. A pressure gauge is having a range of 1000 kPa and guaranteed accuracy of 1% FSD. It is used to measure a pressure of 100kPa. The possible limits for this reading will be ~~[90 to 110]~~ kPa. If the accuracy was 1% of the measured value, it will have limits of ~~99 to 110~~ kPa.

4. A spring scale requires a change of 15 N in the applied weight to produce 2cm change in deflection of the spring. This spring has static sensitivity equal to  $K_s = \frac{2\text{cm}}{15\text{N}} = 0.1333 \text{ cm/N}$

5. A pressure gauge is calibrated from 0-50 kPa. It has uniform scale with 100 divisions. One-Fifth of the scale can be read with fair degree of accuracy. The gauge has:

Resolution of 0.1 kPa. ~~Threshold of 0.1 kPa.~~ Dead zone of 0.2 kPa.  
 Resolution of 0.5 kPa. None of the above is correct.

6. For the following system represented by the following differential equation :

$$4.5 \frac{d\theta_o}{dt} + 3\theta_o = 1.5 \cdot 10^{-3} \theta_i$$

the time constant ( $\tau$ ) =  $1.5 \cdot 10^{-3}$  sec and the static sensitivity ( $k_s$ ) is =  $0.5 \cdot 10^{-3}$

$$\frac{4.5}{3} = \tau$$

$$k_s = \frac{1.5 \cdot 10^{-3}}{3}$$

لا تستخدم اختصارات في اجابتك واشرح كل خطوة تقوم بها والا سيعتبر الحل خاطئ حتى لو كان صحيحا

Explain the steps of your answer

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**Q2)** A U-tube manometer was subjected to step pressure input that caused the manometer fluid to be displaced by 40mm. The first, second and third overshoot have values 20mm, 10mm and 5mm respectively. The first overshoot occurred after 1.2 seconds from application of pressure. **(4 Marks)**

- Calculate the damping ratio for this manometer fluid, the natural and damped natural frequencies, rise time.
- If the volume of the manometer liquid is halved how much should be the value of the parameters of part (A).

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**Q3)** A Methyl alcohol ( $\text{CH}_3\text{-OH}$ ) thermometer has capillary tube of 0.25mm diameter. The bulb is made of zero-expansion material. Take the physical properties of the mercury as follows; Density =  $0.7918 \text{ g/cm}^3$ , specific heat =  $2510 \text{ J/kg}^\circ\text{C}$ , coefficient of volumetric expansion =  $0.00119 \text{ }^\circ\text{C}^{-1}$  and heat transfer coefficient across the bulb =  $60 \text{ J/m}^2 \text{ s }^\circ\text{C}$ . **(8 Marks)**

- What type of system thermometer is (Zero, First, Second or Higher). How did you know?
- What does that mean?
- If the sensitivity is to be made  $3\text{mm/ }^\circ\text{C}$ , what volume should the spherical bulb have?
- How much will be its time constant?
- If the spherical bulb is changed to cylindrical one with 7mm height. Keeping the sensitivity as in part (3) How much should be its diameter?
- How much will be the new time constant (if it changes).
- If this thermometer is suddenly subjected to step input of  $25^\circ\text{C} - 125^\circ\text{C}$ , what temperature will it indicate after 10 seconds from the start of the process.
- State FOUR main qualities preferred to be for the thermometer liquid (other than cheap and available).

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**Q4)** In a test, temperature is measured several times with variations in apparatus and procedures. After applying the known corrections, the results are: **(5 Marks)**

Temperature $^\circ\text{C}$	10	11	12	13	14
Frequency of occurrence	3	10	20	11	4

- What type of test is this?
- What type of errors are present in the data?
- Calculate:
  - arithmetic mean, (b) deviation, (c) mean deviation, (d) standard deviation, (e) the probable error of one reading, (f) Variance, (g) precision Index, (h) based on Chauvenet's theory, which data is to be rejected (Show one cycle only). What are the steps taken to assure that the data is authentic? How do you finally represent your data?