

**JORDAN UNIVERSITY**  
**FACULTY OF ENGINEERING & TECHNOLOGY**  
**DEPARTMENT OF MECHANICAL ENGINEERING**  
**ENGINEERING MEASUREMENTS (0904423)**  
**Quiz-2 (2), SECOND SEMESTER 2007-2008**  
**Dr. Jehad A. A. Yamin**      **Date: 8<sup>th</sup> April, 2008**  
**Time: 15 minutes.**      **(25 Points)**

**Name : ..... Univ. No. : .....**

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

$1.5 \frac{d\theta_o}{dt} + 5 \theta_o = 7.5 \times 10^{-3} \theta_i$  . Define the time constant and static sensitivity showing their equations, then, calculate the time constant ( $\tau$ ), the static sensitivity ( $k_s$ ) and the temperature indicated by this system after 4 seconds if a step temperature of 100 °C from zero was applied to it. **(10 Points)**

B. For the first order system response to step input, as the time constant decreases, the dynamic error ..... and settling time ..... **(5 Points)**

C. A submarine, carrying a first order thermometer with a 15 second time constant, sinking in the ocean at a speed of 15 m/s. Assume temperature varies with depth at a rate of 0.075°C/m. The submarine gives information about temperature and depth through radio signals. At a depth of 150 m, the submarine radios a temperature 15°C. What is the true altitude at which 15°C occurs? Explain what happened. **(10 Points)**

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A second-order system represented by the following equation:

$$\frac{d^2\theta_o}{dt^2} + 1.5 \times 10^3 \frac{d\theta_o}{dt} + 1 \times 10^{10} \theta_o = 2 \times 10^{11} \theta_i .$$

Define the following terms:

1) Rise time : -----

2) Peak time : -----

This system will have natural frequency equals to ..... rad/s,  
damping ratio equals to .....

If this system was subjected to step input find the following response parameters :

Phase angle of ..... degrees,

Peak overshoot ..... %

Peak Time equals to: ..... seconds,

Rise time equals to ..... seconds, and

Settling time equals to ..... seconds for  $\pm 2\%$  error.

A. For the first order system response to ramp input, as the time constant increases, the dynamic error ..... , lag ..... and settling time ..... (5 Points)

B. A submarine, carrying a first order thermometer with a 10 second time constant, sinking in the ocean at a speed of 15 m/s. Assume temperature varies with depth at a rate of  $0.05^{\circ}\text{C}/\text{m}$ . The submarine gives information about temperature and depth through radio signals. At a depth of 250 m, the submarine radios a temperature  $15^{\circ}\text{C}$ . What is the true altitude at which  $15^{\circ}\text{C}$  occurs? Explain what happened. (10 Points)