

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: 8th April, 2008

Time: 15 minutes.

(25 Points)

Name : Univ. No. :

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 (τ), 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)**

Wish You the Best

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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°C . What is the true altitude at which 15°C occurs? Explain what happened. (10 Points)

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