ENG4550: Introduction to Control Systems

Sec 2.2 Pre-lab Questions

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Lab #: 3

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Prelab 3.

1. $e_{ss}=0$, $t_p=0.2$, $PO=50\%$.

$$\theta(t_p) = \left(\frac{\pi}{4}\right)\left(1+\frac{PO}{100}\right)$$

$$\theta(t_p) = 1.05\left(\frac{\pi}{4}\right) \text{ rad}$$

2. $\omega_n^2 = K K_p/\tau$ $\qquad \frac{1+KK_v}{\tau} = 2\zeta\omega_n$

$K_p = \frac{\omega_n^2 \tau}{K}$ $\qquad K_v = \frac{2\zeta\omega_n - 1}{K}$

3. $0.2 = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$ $\qquad \zeta \geq \sqrt{\frac{\ln(M_p)^2}{\pi^2+\ln(M_p)^2}} \geq 0.69$

$\omega_n = 21.70$

4. $\frac{\Theta_1(s)}{\Theta_d(s)} = \frac{KK_p/\tau}{s^2 + \frac{(1+KK_v)}{\tau}s + \frac{KK_p}{\tau}}$

$\frac{KK_p}{\tau} = \omega_n^2$ $\qquad \frac{1+KK_v}{\tau} = 2\zeta\omega_n$

$K_p = 7.8186836477$ $\qquad K_v = -0.15645202$

6. $e_{ss} = \lim_{s\to 0} s\,E(s) = \frac{R_0(1+KK_v)}{K\cdot K_p} = \frac{2.557}{11.96} = 0.21375$

7. $V_m = K_i e_{ss} + K_i \int_0^{t_1} e_{ss}\,dt$

$10 = (7.819)(0.21375) + K_i(0.21375)(1)$

$K_i = 38.965$

Hilroy