

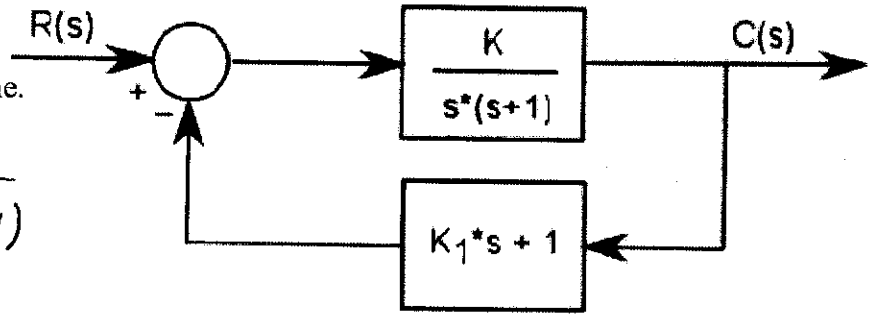
KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

EE380 [081]	SEC# _____	Quiz # 5
Name: <u>Model Solution</u>	ID: _____	Grade: _____

Find K and K_1 such that the system meets the following specifications:

- 1) Maximum P.O. to a step input is 25%.
- 2) Peak time is 2 seconds

Also find the rise time and the settling time.



$$T(s) = \frac{C(s)}{R(s)} = \frac{K}{s(s+1) + K(K_1s+1)}$$

$$= \frac{K}{s^2 + (1+KK_1)s + K}$$

$$P.O. = 25\% \Rightarrow \zeta = \frac{\ln 4}{\sqrt{\pi^2 + (\ln 4)^2}} = 0.404$$

$$T_p = \frac{\pi}{\omega_n \sqrt{1-\zeta^2}} = 2 \Rightarrow \omega_n \sqrt{1-\zeta^2} = \frac{\pi}{2} \Rightarrow \omega_n^2 (1-\zeta^2) = \frac{\pi^2}{4}$$

$$\therefore \omega_n = 1.717$$

$$K = \omega_n^2 = 2.95$$

$$1 + KK_1 = 2\zeta\omega_n = 1.387$$

$$KK_1 = 0.387 \Rightarrow K_1 = 0.1313$$

$$T_r = \frac{2.16\zeta + 0.5}{\omega_n} = 0.86 \text{ sec}$$

$$T_s = \frac{4}{\zeta\omega_n} = 5.76 \text{ sec}$$

$$s = -0.69 \pm j1.57$$

