

Homework 5

Assignment 1

$$y(s) = \frac{q(s)b(s)}{p(s)a(s)} \cdot \frac{r(s)}{1 + \frac{q(s)b(s)}{p(s)a(s)}} \cdot y_r(s)$$

$$y(s) = \frac{q(s)b(s)r(s)}{(p(s)a(s) + q(s)b(s))p(s)} \cdot y_r(s)$$

$$\deg(q(s)b(s)r(s)) \leq \deg(p(s)a(s) + q(s)b(s))p(s)$$

Assignment 2

$$y(s) = \frac{\frac{b(s)q(s)}{p(s)a(s)}}{1 + \frac{b(s)q(s)}{p(s)a(s)}} \cdot r(s) \cdot y_r(s)$$

$$= \frac{b(s)q(s) \cdot r(s)}{p(s)q(s) + b(s)q(s)} \cdot y_r(s)$$

$$\deg(b(s)q(s)r(s)) \leq \deg(p(s)a(s) + b(s)q(s))$$

Assignment

$$Ty_0 = \frac{P_2(1 - FP_1)}{1 + P_2 P_1 C}$$

when $1 + P_2 P_1 C$ is large

$$1 - FP_1 = 0$$

$$FP_1 = 0$$

$$F = P_1^{-1}$$

$$F = \frac{s+1}{s+2}$$

$$P_2 P_1 = \frac{s+2}{(s+1)(s-1)}$$

$$y(s) = \frac{P_2(1 - FP_1)d(s)}{1 + P_2 P_1 C} + \frac{P_2 P_1 C}{1 + P_2 P_1 C}$$

$$y(s) = \frac{P_2 P_1 C}{1 + P_2 P_1 C}$$

$$= \frac{s+2}{(s+1)(s-1)} \cdot C$$

$$= \frac{s+2}{1 + \frac{s+2}{(s+1)(s-1)} \cdot C} \cdot C$$

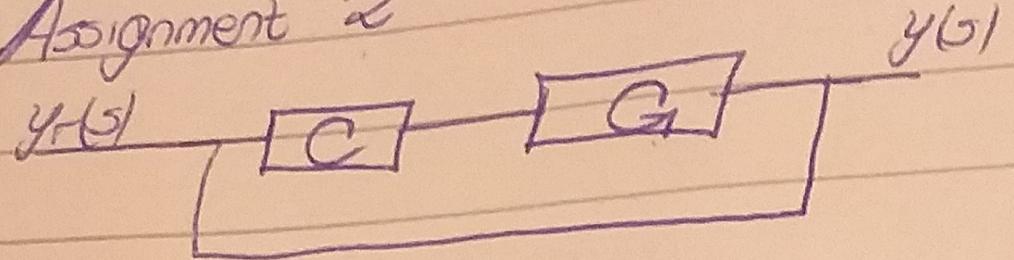
$$= \frac{s+2}{s+1 + (s+2)C} \cdot \frac{s+2}{s^2 + s - 2 + (s+2)C} \cdot C$$

$$C = \frac{K_C}{b(s)q(s)} = \frac{1}{s+2}$$

$$\begin{aligned} & s^2 - 1 + 2C(s+2) \\ & s^2 + 2Cs + 4C - 1 \\ & C(s+2) + (s+1)(s-1) \end{aligned}$$

$$\begin{aligned} & s^2 + C_0 + 2C - 1 \\ & C > 0 \quad 2C - 1 > 0 \\ & C > \frac{1}{2} \\ & C = 1 \end{aligned}$$

Assignment 2



$$Y(s) = \frac{GC}{1+GC} \quad G = P_2 P_1 = \frac{s+2}{s^2-1}, \quad C = K \frac{s+2}{s+P}$$

$$F(s) = \frac{Z}{s+Z}$$

$$\begin{aligned} T_{fb} &= \frac{K(s+Z)}{s^3 + Ps^2 - s - P + Ks + Kz} \\ &= \frac{K(s+Z)}{s^3 + Ps^2 + (K-1)s + Kz - P} \end{aligned}$$

$$T_{ceil} = \frac{Kz}{s^3 + Ps^2 + s - P + Ks + Kz}$$

$$= \frac{Kz}{s^3 + Ps^2 + (K-1)s + Kz}$$

$$\text{Let } T_5 = 2, \quad w_n = \frac{4.04}{T_5} = 2.02$$

from table $\alpha = 1.9, B = 2.2$

$$s^2: P = \alpha w_n = 1.9 \times 2.02 = 3.838$$

$$s: K-1 = B w_n^2 \Rightarrow K-1 = 3.97638, \quad K = 9.97638$$

$$Kz = w_n^3 \Rightarrow Z = \frac{w_n^3}{K} = \frac{2.02^3 + 3.838}{9.97638} = 1.21084$$

$$C = \frac{5 + 1.21084}{5 + 3.838} \cdot 9.97638$$