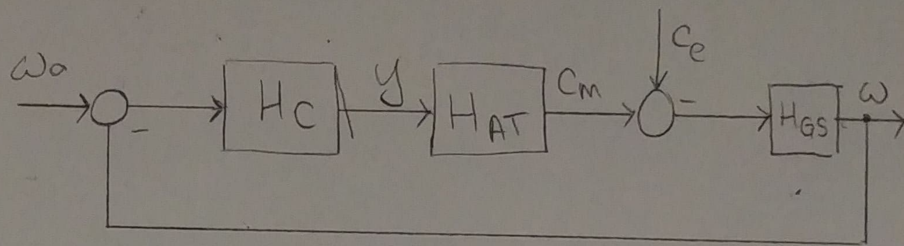
$$H_C = \frac{K_R(1+8s)}{1+20s} \; ; \alpha \in (0, 1.2]$$

$$H_{AT} = \frac{1-4s}{1+2s} \qquad K_R > 0$$

$$H_{GS} = \frac{1}{\alpha + 7s}$$



b) $K_{R_0} = K_{R_{max}}/4$, $\alpha = 0.2$ controlled process - stabli

$$\alpha = 0.2 \Rightarrow H_{GS}(s) = \frac{1}{0.2+7s}$$

$$K_{R_{max}} = 4.9918 \Rightarrow K_{R_0} = 4.9918/4 = 1.2479 > 0 \checkmark$$

(initial condition)

$$\Rightarrow H_C = \frac{1.2479 + 9.9832s}{1+20s}$$

$$H_{\omega\omega_0}(s) = \left.\frac{\omega(s)}{\omega_0(s)}\right|_{C_e=0} = \frac{H_C(s)\cdot H_{AT}(s)\cdot H_{GS}(s)}{1+H_C(s)\cdot H_{AT}(s)\cdot H_{GS}(s)}$$

$$\Delta(s) = 1 + H_0(s) = 1 + H_C(s)\cdot H_{AT}(s)\cdot H_{GS}(s)$$

$$H_{\omega C_e}(s) = \left.\frac{\omega(s)}{C_e(s)}\right|_{\omega_0=0} = -\frac{H_{GS}(s)}{1+H_{GS}(s)\cdot H_C(s)\cdot H_{AT}(s)}$$

$$H_{\omega\omega_0}(s) = \frac{\frac{(1.2479+9.9832s)}{1+20s}\cdot\frac{1-4s}{1+2s}\cdot\frac{1}{0.2+7s}}{1+\frac{(1.2479+9.9832s)(1-4s)(1)}{(1+20s)(1+2s)(0.2+7s)}}$$

$$= \frac{(1.2479+9.9832s)(1-4s)}{(1+20s)(1+2s)(0.2+7s)+(1.2479+9.9832s)(1-4s)}$$

$$\Delta(s) = (1+20s)(1+2s)(0.2+7s) + (1.2479+9.9832s)(1-4s)$$

$$= (1+40s^2+22s)(0.2+7s) + 1.2479 + 9.9832s - 4.9916s - 39.9328s^2$$

$$= 280s^3 + 162s^2 + 11.4s + 0.2 + 1.2479 + 4.9916s - 39.9328s^2$$

$$= 280s^3 + 122.0672s^2 + 16.3916s + 1.4479$$

All coefficients > 0 => initial stability conditions ✓

$$n=3 \Rightarrow H_3 = \begin{bmatrix} a_2 & a_0 & 0 \\ a_3 & a_1 & 0 \\ 0 & a_2 & a_0 \end{bmatrix} = \begin{bmatrix} 122.0672 & 1.4479 & 0 \\ 280 & 16.3916 & 0 \\ & 122.0672 & 1.4479 \end{bmatrix}$$

$$\det H_1 = 122.0672 > 0$$

$$\det H_2 = 122.0672 \cdot 16.3916 - 280 \cdot 1.4479$$
$$= 1595.464716 > 0$$

$$\det H_3 = (\det H_2) \cdot 1.4479 =$$
$$= 2310.0733 > 0$$

=> The controlled system is stable for the given α and K_R