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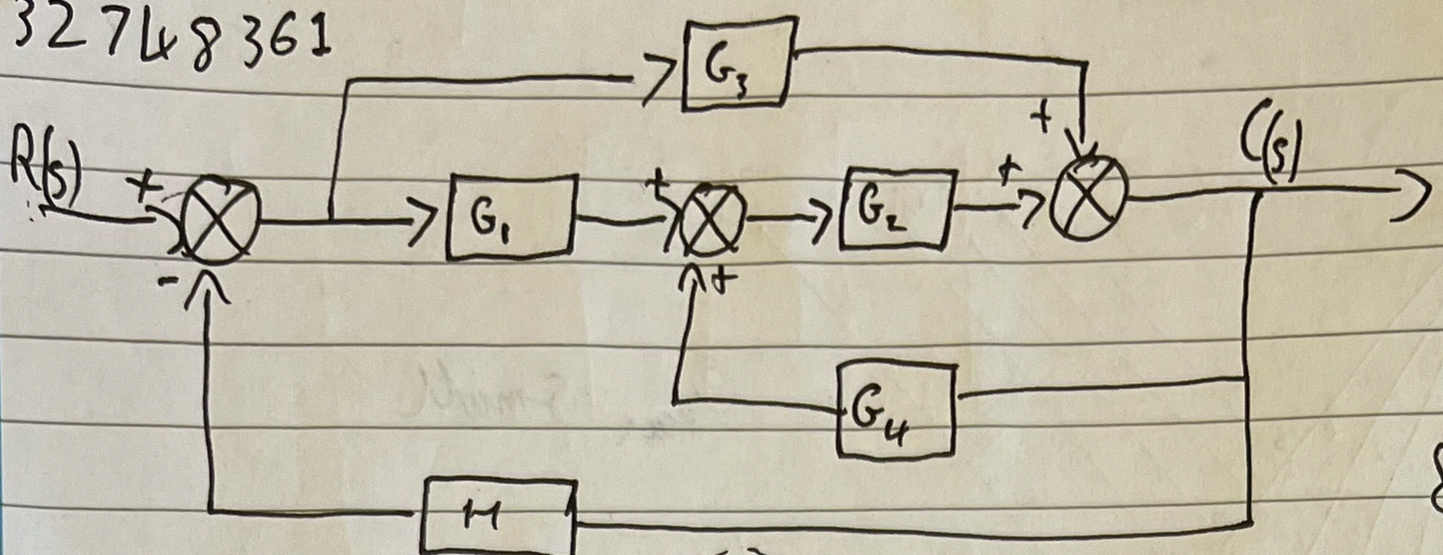
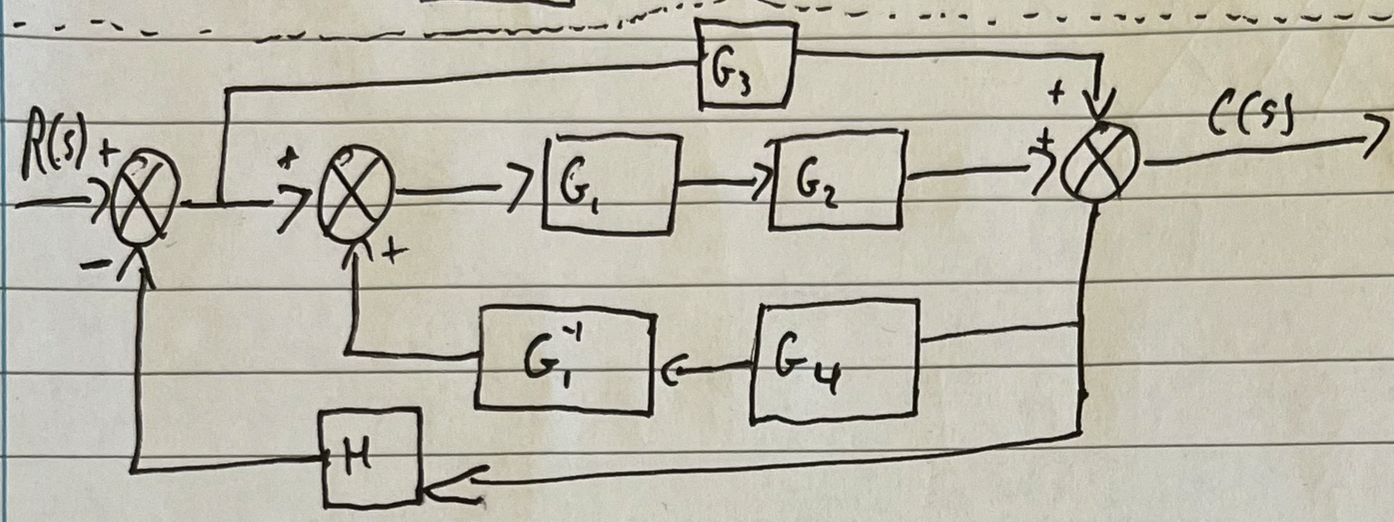
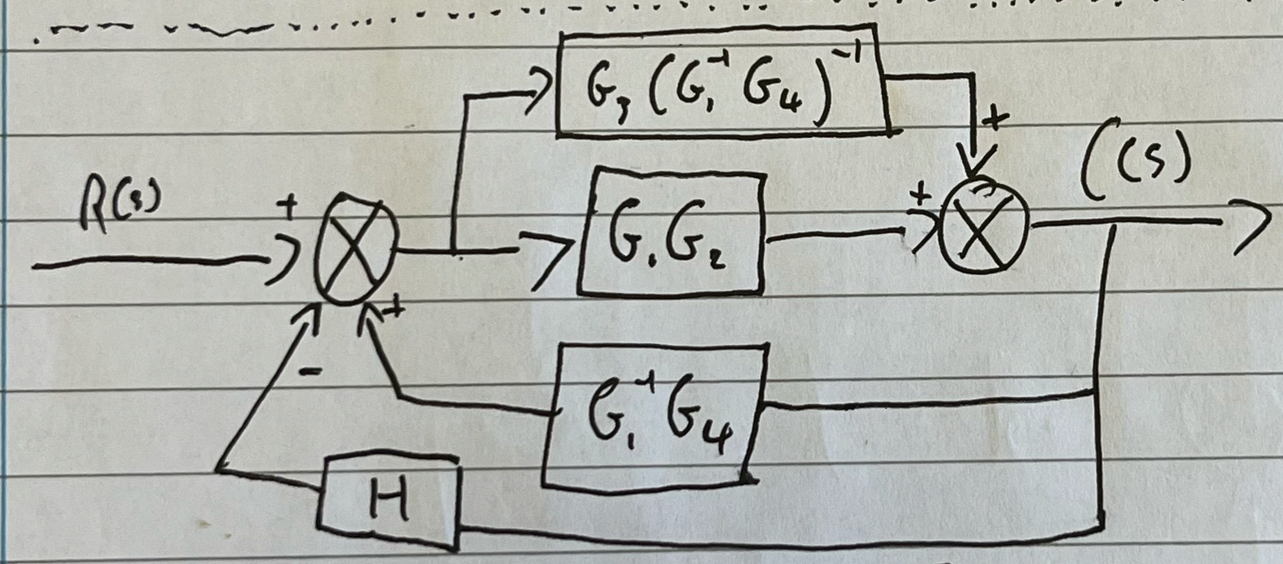
SESA 3030 Assignment 1 Q 1



move G_1 forward

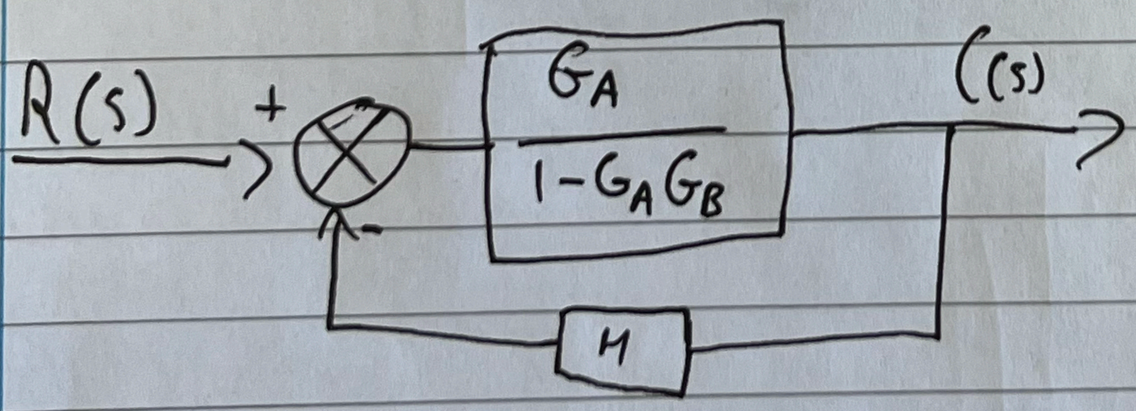


Simplify and move G_3



$$G_A = G_1G_2 + G_3(G_1^{-1}G_4)^{-1}$$

$$G_B = G_1^{-1}G_4$$



$$\frac{R}{C} = \frac{\frac{G_A}{1-G_AG_B}}{1+\frac{G_A}{1-G_AG_B}}$$

Simplify

$$R(s) \longrightarrow \boxed{\frac{G_1(G_2G_4+G_3)}{G_1H(G_2G_4+G_3)+G_4(-G_2G_4-G_3+1)}} \longrightarrow C(s)$$

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$\frac{C}{R} = \frac{300}{s^2+10s+400}$ $G(s) = \frac{K\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$

a) $\omega_n^2 = 400$ $\omega_n = 20$

$2\zeta\omega_n = 10$ $\zeta = 0.25$

b) $K\omega_n^2 = 300$ $K = 0.75$

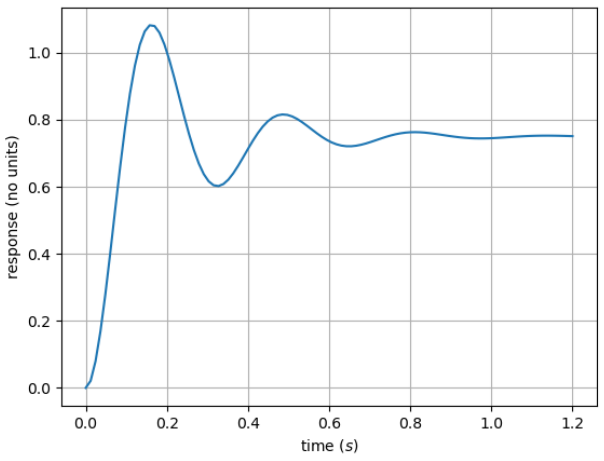
c) $T_s = \frac{3}{\omega\zeta}$ for 5% error of steady state value

$T_s = 0.6$

d) $P.O. = 100\exp\left(-\frac{\pi\zeta}{\sqrt{1-\zeta^2}}\right) \simeq 44.4\%$

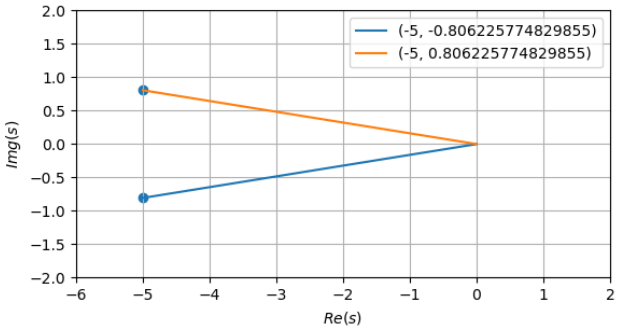
e) $T_p = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}} \simeq 0.16$

f)



$\phi = 14.48°$

g)



Natalie Ko-Ferrigno SESA 3030 Assignment 1 Q 3

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$$\frac{d^3x}{dt^3} + \frac{dx}{dt} + 4x^2 = e^{-2t^3} \qquad f(x) \approx f(x_0) + \left.\frac{df}{dx}\right|_{x_0} (x - x_0)$$

$$4x^2 \approx 4x_e^2 + 8x_e(x - x_e)$$

$$e^{-2t^3} \approx e^{-2t_e^3} - 6t_e^2 e^{-2t_e^3}(t - t_0)$$

$$\frac{d^3x}{dt^3} + \frac{dx}{dt} + 4x_e^2 + 8x_e(x - x_e) = e^{-2t_e^3}\left(1 - 6t_e^2(t - t_e)\right)$$