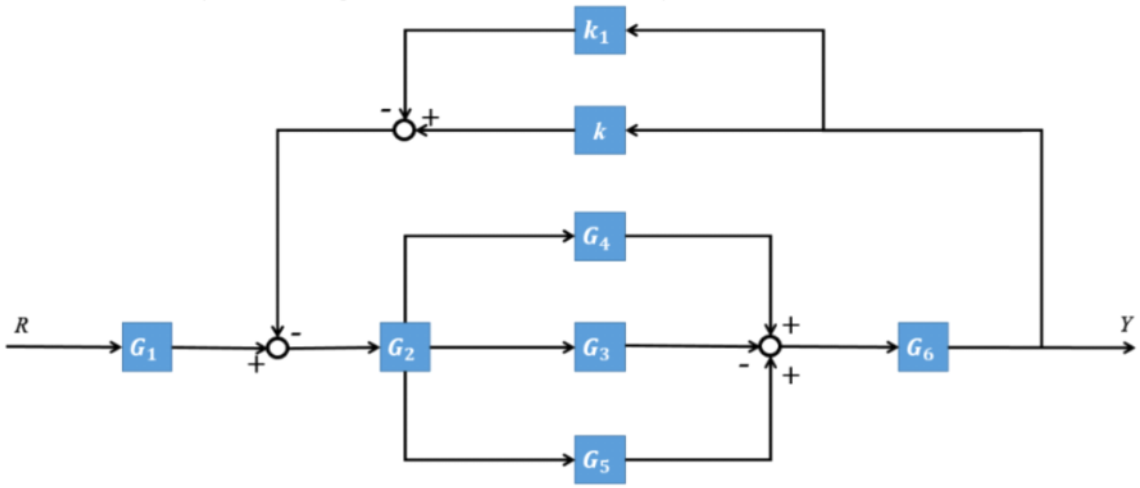
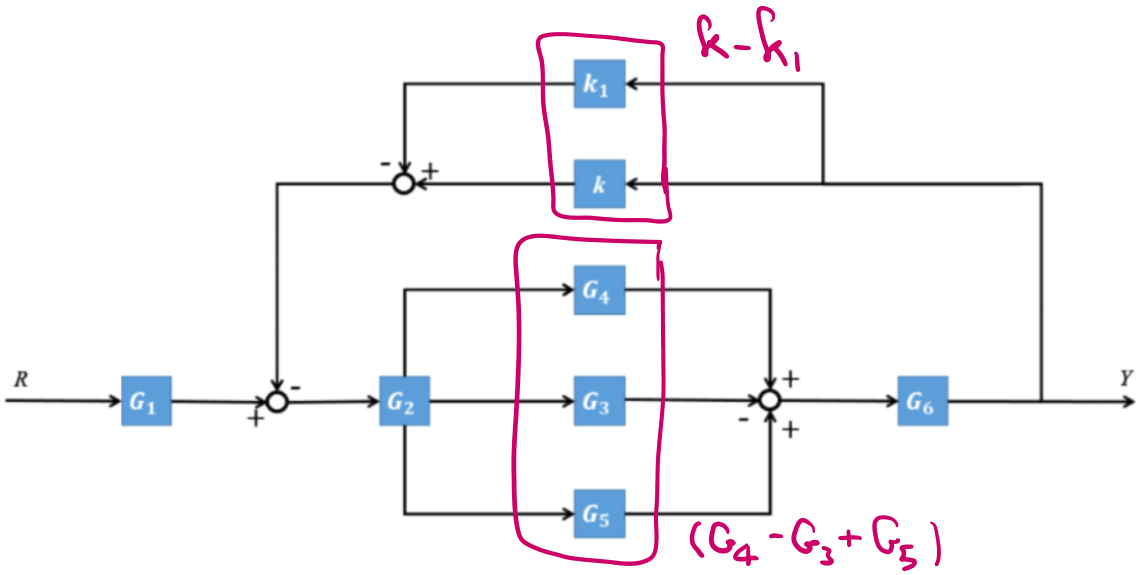
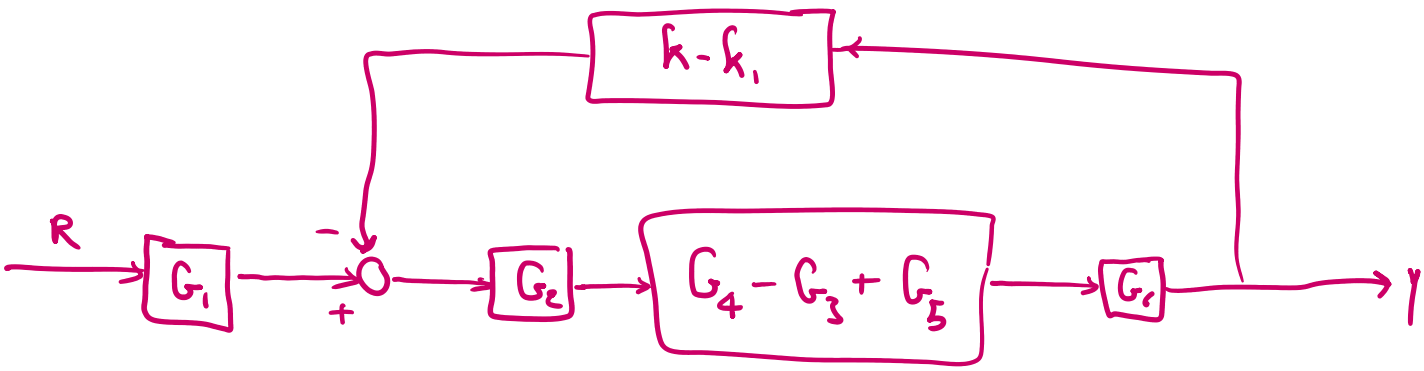
Control midterm q1

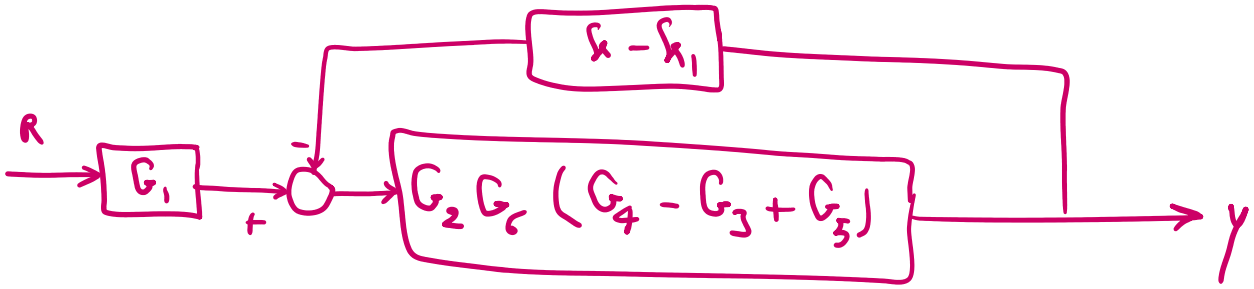
Thursday, December 2, 2021 5:49 PM

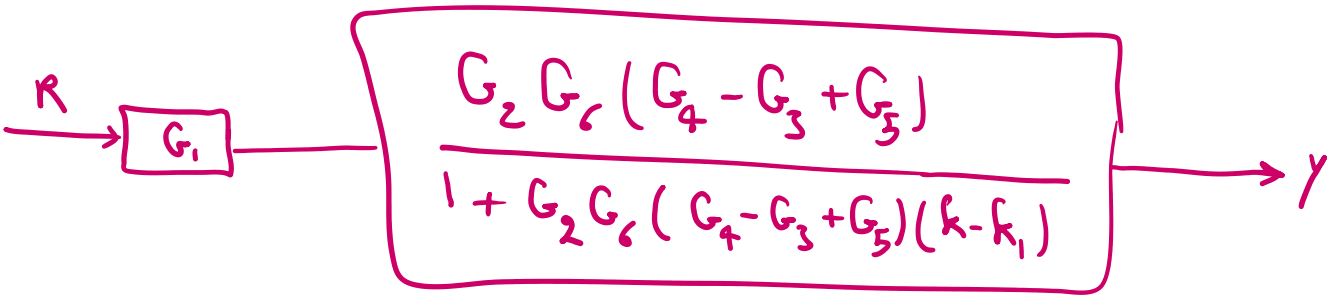
Find the transfer function for the system in Figure. Determine the sensitivity .

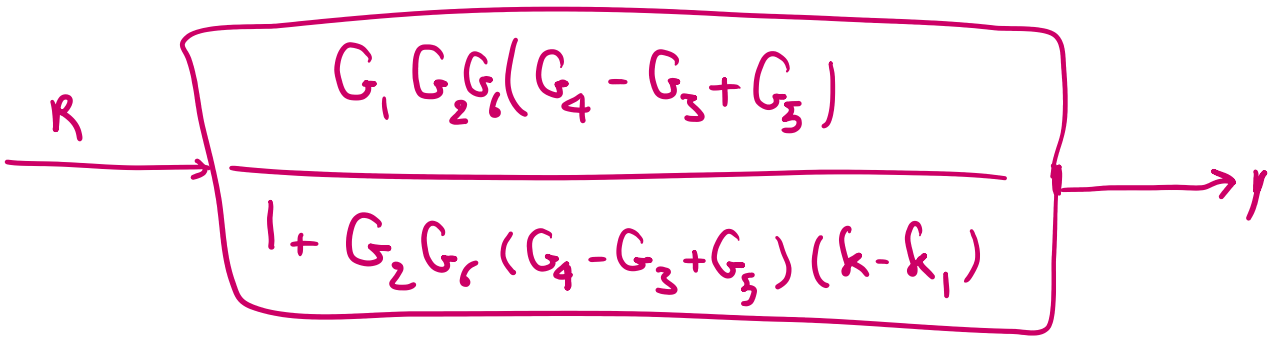






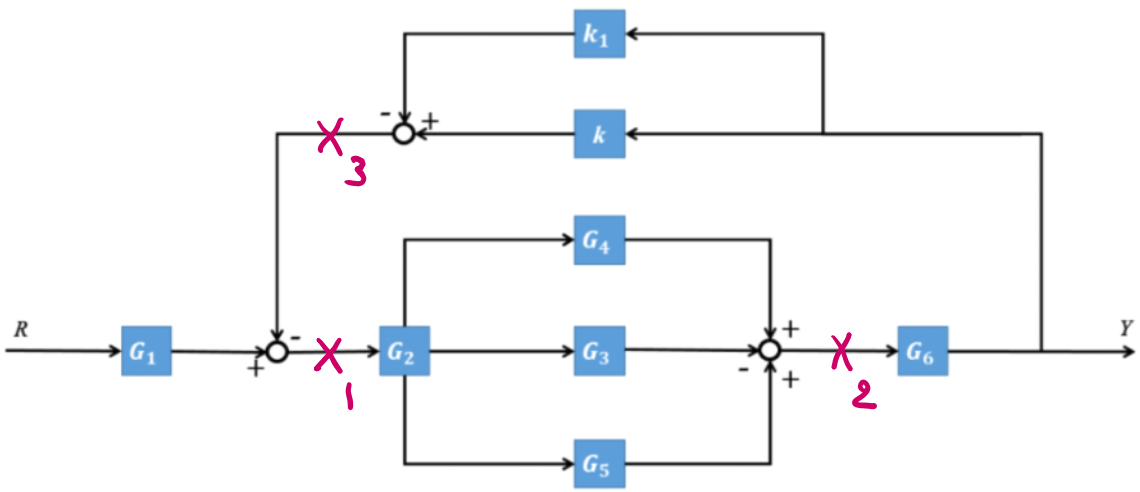






$$T = \frac{y}{R} = \frac{G_1 G_2 G_6 (G_4 - G_3 + G_5)}{1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)}$$

Second Method



$$\begin{cases} X_1 = G_1 R - X_3 & (1) \\ X_2 = X_1 G_2 (G_4 - G_3 + G_5) & (2) \end{cases} \quad \text{and} \quad Y = X_2 G_6 \quad (4)$$

$$\begin{cases} X_2 = X_1 G_2 (G_4 - G_3 + G_5) \quad (2) \quad \text{and} \quad Y = X_2 G_6 \quad (4) \\ X_3 = Y(k - k_1) \quad (3) \end{cases}$$

(1), (3) and (4) $\Rightarrow$ $X_1 = G_1 R - Y(k - k_1) = G_1 R - X_2 G_6 (k - k_1)$ (5)

(5), (2) $\Rightarrow$ $X_2 = [G_1 R - X_2 G_6 (k - k_1)] G_2 (G_4 - G_3 + G_5) \Rightarrow$

$$X_2 = \frac{G_1 G_2 (G_4 - G_3 + G_5)}{1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)} R \quad (6)$$

(4) into (6) $\Rightarrow$ $Y = \dfrac{G_1 G_2 G_6 (G_4 - G_3 + G_5)}{1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)} R \Rightarrow$

$$T = \frac{Y}{R} = \frac{G_1 G_2 G_6 (G_4 - G_3 + G_5)}{1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)}$$

$$S_k^T = \frac{\frac{\partial T}{T}}{\frac{\partial k}{k}} = \frac{\partial T}{\partial k} \frac{k}{T}$$

$$S_k^T = \frac{0 - (G_2 G_6 (G_4 - G_3 + G_5))[G_1 G_2 G_6 (G_4 - G_3 + G_5)]}{[1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)]^2} X$$

$$\frac{k}{\dfrac{G_1 G_2 G_6 (G_4 - G_3 + G_5)}{1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)}} \Rightarrow$$

$$1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)$$

$$S^T_k = -\frac{k G_2 G_6 (G_4 - G_3 + G_5)}{1 + G_2 G_6 (G_4 - G_3 + G_5)(k - k_1)}$$