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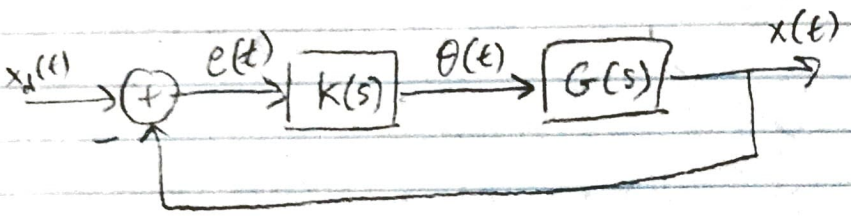
Pre-lab 5

2) $e(t) = x_d(t) - x(t)$



3) $$\begin{cases} E(s) = X_d(s) - X(s) \\ \theta(s) = K(s) \cdot E(s) \end{cases}$$

So

$$\boxed{\frac{\theta(s)}{X_d(s)} = \frac{K(s)}{1 + K(s)G(s)}}$$

4) $\theta(t)\big|_{t=0} < 30^\circ$ or $\frac{\pi}{6}$ rad ← Specification 3

$$\theta(s) = \frac{K(s)}{1 + K(s)G(s)} \cdot X_d(s) = \frac{1}{s} \cdot \frac{K(s)}{1 + K(s)G(s)}$$

$$G(s) = \frac{7}{s^2}$$

$$K(s) = \frac{K \prod_{i=1}^{m} (s - z_i)}{\prod_{j=1}^{m} (s - P_j)}$$

$$\theta(t)\big|_{t=0} = \lim_{s \to \infty} s \cdot \theta(s) = \lim_{s \to \infty} \frac{K(s)}{1 + K(s)G(s)}$$

$$= K$$

So $\boxed{K < \frac{\pi}{6}}$

5) $\frac{X(s)}{X_d(s)} = \frac{\theta(s) \cdot G(s)}{X_d(s)}$

$\frac{X(s)}{X_d(s)} = \frac{K(s) \cdot G(s)}{1 + K(s)G(s)}$

6) specification $2 \leq T_s \leq 4$

$T_s = \frac{4.6}{\sigma}$

$\sigma = \frac{4.6}{T_s}$

$\Rightarrow$ $\boxed{1.15 \leq \sigma \leq 2.3}$

7) dominant poles

compare the real parts of poles since the real parts determine the speed of the response. decrease.

poles $-\delta\omega_n \pm j\omega_n\sqrt{1-\delta^2}$

$-\alpha_r$

step response $C(s) = \frac{A}{s} + \frac{B(\delta\omega_n + s) + C\omega_d}{(s+\delta\omega_n)^2 + \omega_d^2} + \frac{D}{s+\alpha_r}$

8) $K(s)G(s)$ should be type 1. Specification 2 is met. There would a 0 tracking error.