# Homework

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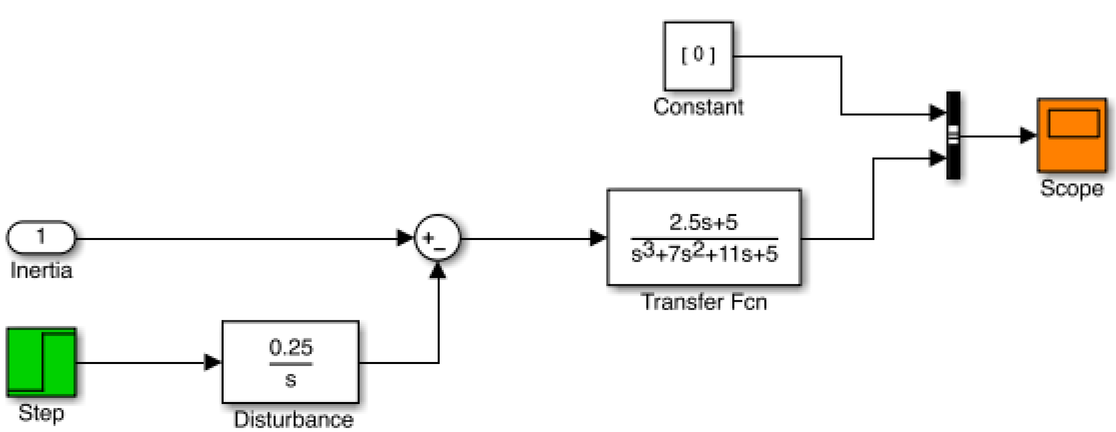
## Homework 2

### Problem 1

$$
\begin{aligned}
\frac{s\omega(s)}{0.25} &= \frac{2.5(s+2)}{(s+5)(s+1)^2} \\
\omega(s) &= \frac{5}{8}\left(\frac{s+2}{s(s+5)(s+1)^2}\right) \\
\omega(s) &= \frac{5}{8}\left(-\frac{7}{16(s+1)} + \frac{3}{80(s+5)} - \frac{1}{4(s+1)^2} + \frac{2}{5s}\right) \\
\omega(t) &= \frac{5}{8}\left(-\frac{1}{4}te^{-t} + \frac{3e^{-5t}}{80} - \frac{7e^{-t}}{16} + \frac{2}{5}\right)
\end{aligned}
$$

### Problem 6




See the attached file, `homework2.slx`.

# Homework 3

## Problem 2

$$\frac{C(s)}{R(s)} = \frac{1}{Ts+1}$$
$$C(s) = \frac{1}{s}\left(\frac{1}{Ts+1}\right)$$
$$C(s) = \frac{1}{s} - \frac{T}{Ts+1}$$
$$C(s) = \frac{1}{s} - \frac{1}{s+(1/T)}$$
$$c(t) = 1 - e^{-1/T}$$
$$0.98 = 1 - e^{-1/T}$$
$$0.02 = e^{-1/T}$$
$$ln(0.02) = -\frac{1}{T}$$
$$T = -\frac{1}{ln(0.02)}$$
$$T \approx 0.2556 \text{ minutes}$$
$$\approx 15.3373 \text{ seconds}$$

## Problem 3

Based on the information supplied, we determine that $J = 1$ and $B = 14$. Next we use the equation $\frac{K}{J} = \omega_n^2$ to determine that $K = \omega_n^2$. Finally we use the equation $\frac{B}{J} = 2\zeta\omega_n$ as follows:

$$B = 2\zeta\omega_n$$
$$7 = \zeta\omega_n$$
$$7 = 0.7\omega_n$$
$$10 = \omega_n$$
$$10^2 = K$$
$$100 = K$$

## Problem 4

We use the information given to determine the following three sets of inequalities in terms of $\omega_d$ and $\sigma$.

Given what we know about *percent overshoot*:

$$M_p \leq e^{-(\sigma/\omega_d)\pi}$$
$$ln(0.05) \leq -\left(\frac{\sigma}{\omega_d}\right)\pi$$
$$\frac{ln(0.05)}{\pi} \leq -\frac{\sigma}{\omega_d}$$

Given what we know about *settling time*:

$$t_s < \frac{4}{\sigma}$$
$$4 > \frac{4}{\sigma}$$
$$\sigma > 1$$

Given what we know about *peak time*:

$$1 > \frac{\pi}{\omega_d}$$
$$\omega_d > \pi$$

Optionally, we locate the poles with the equation $s_{1,2} = -\sigma \pm j\omega_d$. Then we plot these inequalities to determine the permissible area for poles of $T(s)$.