

$$G(s) = \frac{160}{(s^2 + 16s + 160)}$$

$$T_p = 0.25 \quad \%OS = 30\%$$

$$e(\infty) = 5\%$$

P-lead-lag

Step input

$$\zeta = \frac{-\ln(\%OS/100)}{\sqrt{\pi^2 + \ln^2(\%OS/100)}} = \frac{-\ln(0.3)}{\sqrt{\pi^2 + \ln^2(0.3)}} = 0.36$$

$$T_p = \frac{\pi}{\omega_d}$$

$$\omega_d = \frac{\pi}{T_p} = \frac{\pi}{0.25} = 12.57$$

$$\omega_d = \omega_n \sqrt{1 - \zeta^2}$$

$$\omega_n = \frac{\omega_d}{\sqrt{1 - \zeta^2}} = \frac{12.57}{\sqrt{1 - 0.36^2}} = 13.47$$

$$\begin{aligned} \psi &= -\zeta \omega_n \pm \omega_d j = -0.36(13.47) \pm 12.57j \\ &= -4.85 \pm 12.57j \end{aligned}$$