Appendix

Design steps of phase lag network

Step 1: Draw the magnitude and phase for G(s) for the uncompensated system.

Step 2: From Bode plot determine the phase margin of the uncompensated system.

Step 3: If ϕ_s = specified phase margin

ε = margin of safety

$\phi = \phi_s + \varepsilon$

Step 4: Determine the frequency corresponding to the required phase margin from the phase curve this frequency is new gain crossover frequency w_m.

Step 5: The magnitude curve is brought down to $0dB$ at the new gain crossover frequency when the phase margin is satisfied, the phase lag network must provide the amount of attenuation equal to the value of magnitude at w'_m

$$\left|G(jw')\right| = -20\log\alpha \qquad\qquad \alpha > 1$$

$$\alpha = 10^{-\left|G(jw')\right|/20}$$

Step 6 : Calculate T from

$$\frac{1}{\alpha T} = \frac{w'_m}{10}$$

Step 7: Draw Bode plot for compensated system and check the phase margin if met or not. If not ad just the value of α and T.