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 \( \phi_s \) = specified phase margin

\[ \varepsilon = \text{margin of safety} \]

\[ \phi = \phi_s + \varepsilon \]

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 \( w'_m \)

\[ |G(jw')| = -20\log \alpha \quad \alpha > 1 \]

\[ \alpha = 10^{\frac{|G(jw')|}{20}} \]

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 adjust the value of \( \alpha \) and \( T \).