System Characteristic Equation

\[ C(z) = \frac{G(z)}{1 + G(z)H(z)} R(z) \]

\[ = \frac{K}{\prod_{i=1}^{m} (z - z_i)} \frac{\prod_{j=1}^{n} (z - p_j)}{\prod_{j=1}^{n} (z - p_j)} R(z) \]

Using this partial-fraction expansion, we can express \( C(z) \) as

\[ C(z) = \left( k_1 \frac{z}{z - p_1} + k_2 \frac{z}{z - p_2} + \cdots + k_n \frac{z}{z - p_n} \right) + C_R(z) \]

Transient Response

Output due to the input (S-S response)

Since the transient response is determined by the roots, \( 1 + G(z)H(z) = 0 \)

1 + G(z)H(z) is the system characteristic eqn.