علی فرزانه ۴۰۱۲۱۳۳۳

۱-۱

$$MP\% = 44.3 = 100\,e^{\frac{-\zeta\pi}{\sqrt{1-\zeta^2}}} \longrightarrow \ln(0.443) = \frac{-\zeta\pi}{\sqrt{1-\zeta^2}}$$

$$\dots \longrightarrow \zeta = 0.25$$

$$\omega_n = \frac{\pi}{0.332\sqrt{1-(0.250)^2}} = 9.77$$

$$y(\infty) = 1.58 \quad , \quad Y(s) = \frac{1}{s}T(s) \longleftarrow$$ ورودی پله

$$\lim_{s\to 0} sY(s) = \lim_{s\to 0} T(s) = k = 1.58$$

$$T = \frac{k\,\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} = \frac{100.97}{s^2 + (4.95)s + 95.5}$$

$$T = \frac{L}{1+L} \longrightarrow L = \frac{T}{1-T}$$: رابطه بین سیستم حلقه باز و بسته

$$\to L = \frac{100.97}{s^2 + (4.95)s - 55.4}$$

۲-۱

حلقه باز : $\frac{W(s)}{R(s)} = L(s) \quad \frac{۰/۴}{s+۰/۲} \longrightarrow \frac{\frac{۰/۴}{s+۰/۲}}{1+\frac{۰/۲}{s+۰/۲}}$

$= \frac{۰/۴}{s+۰/۴} \times 1 \longrightarrow L(s) = \frac{۰/۴}{s+۰/۴}$

حلقه بسته : $\frac{W(s)}{R(s)} = \frac{۰/۴}{s+۰/۸}$ $\longleftarrow$ مانند بخش بالا حساب می کنیم

۱-۳

$$\frac{\frac{14}{s^2+4s}}{1+\frac{14}{s^2+4s}} = \frac{14}{s^2+4s+14}$$

ورودی پله

$$E(s) = \left(1-\frac{14}{s^2+4s+14}\right)\frac{1}{s} = \frac{s^2+4s}{s\left(s^2+4s+14\right)}$$

$$e_{ss} = \lim_{s\to 0} E(s) = 0$$

$$MP\% = 100\, e^{\frac{-\zeta\pi}{\sqrt{1-\zeta^2}}} \qquad \omega_n = 4 \longrightarrow \zeta = 0.5$$

$$\longrightarrow MP\% = 100\, e^{\frac{-0.5\pi}{\sqrt{1-0.25}}} = \boxed{16.303\%}$$

$$t_s = \frac{3.2}{\zeta\omega_n} = \frac{3.2}{2} = \boxed{1.6} \qquad 0 < \zeta < 0.69$$

$$t_s = \frac{4}{2} = 2 \qquad \zeta \in ow$$

$$Mp = 0.05 = e^{\frac{-\zeta\pi}{\sqrt{1-\zeta^2}}} \longrightarrow \dots\ \zeta = 0.6901$$ ۲-۳

$$2\zeta\omega_n = 4 \longrightarrow \omega_n = 2.89$$

$$K = \omega_n^2 = 8.3521$$

۳-۳

$$K = 4 = \omega_n^2 \longrightarrow \omega_n = 2 \longrightarrow \zeta = 1 \longrightarrow M_p = 0$$ ۴-۳

۴-

$$\frac{Y(s)}{D(s)} = \frac{G}{1+kG} \qquad E(s) = \left(1 - \frac{kG}{1+kG}\right)\frac{1}{s}$$

$$e_{ss} = \lim_{s\to 0} sE(s) = -B \longrightarrow \frac{kG(0)}{1+kG(0)} = B+1 \Longrightarrow G(0) = -\frac{1+B}{Bk}$$

$$\frac{Y(s)}{R(s)} = \frac{kG}{1+kG} \xrightarrow{\text{ورودی پله}} e_{ss} = \lim_{s\to 0}\left(1 - \frac{kG}{1+kG}\right) = 1 - \frac{kG(0)}{1+kG(0)}$$

$$= \frac{1}{1+kG(0)} = \frac{1}{1+k\left(-\frac{1+B}{Bk}\right)} = -B = e_{ss}$$

٥-

$$E(s) = \int_0^\infty e(t)\, e^{-st}\, dt \longrightarrow s=0 : E(0) = \int_0^\infty e(t)\, dt$$

$$E(s) = (1 - T(s))R(s) \qquad e_{ss} = \lim_{s\to 0} E(s) \to 1 - T(s) \to \frac{1-T(0)}{0} = \frac{0}{0}$$

$$\xrightarrow[\text{Hop}]{\text{رفع ابهام}} \lim_{s\to 0}\left(-T'(s)\right) \longrightarrow \frac{n a_n s^{n-1} + (n-1)a_{n-1} s^{n-2} + \dots + a_1}{m b_m s^{m-1} + (m-1) b_{m-1} s^{m-2} + \dots + b_1}$$

$$s\to 0 \quad = -\frac{a_1}{b_1}$$