Subject :

Year. Month. Date. ( )

تمرین شماره ۲ کنترل خطی نیلوفر ملا ۴۰۱۲۲۹۰۳

۱- معیار ۲٪

$$T(s) = \frac{K\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

$$M_p = 0/443 \qquad t_p = 0/332 \qquad y_{ss} = 1/058$$

$$t_s = 1/41$$

اطلاعات مسئله

$$M_p = e^{-\frac{\xi\pi}{\sqrt{1-\xi^2}}} = 0/443 \longrightarrow \frac{-\xi\pi}{\sqrt{1-\xi^2}} = \ln(0/443)$$

$$\longrightarrow \frac{\xi\pi}{\sqrt{1-\xi^2}} = 0/813 \longrightarrow \xi = \sqrt{\frac{0/813^2}{\pi^2 + 0/813^2}} \simeq 0/405$$

$$T_p = \frac{\pi}{\omega_n\sqrt{1-\xi^2}} = \frac{\pi}{\omega_n\sqrt{1-0/405^2}} \longrightarrow \omega_n = \frac{\pi}{0/332\sqrt{1-0/405^2}} \simeq 10/053$$

حلقه بسته $H(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2} = \frac{110/92}{s^2 + 8/051 s + 110/92}$

$H(s) = \frac{G(s)}{1+G(s)}$ ← تابع تبدیل حلقه باز

$$\longrightarrow G(s) = \frac{H(s)}{H(s)-1} = \frac{110/92}{8/051}$$

MOHASSEL

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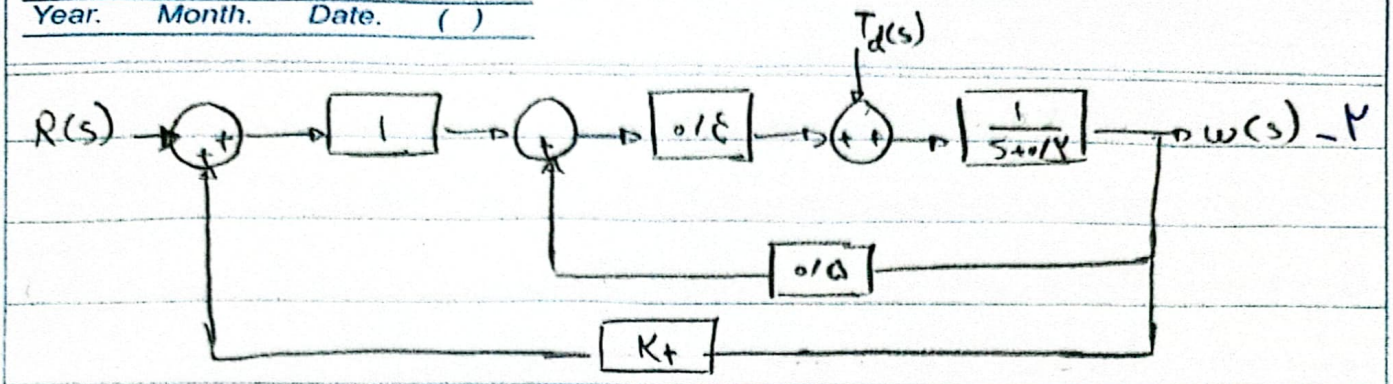

۲- C(s)

الف) حلقه باز $K_t = 0$

$$\frac{C}{R} = \frac{\frac{0.4}{s+0.2}}{1 - \frac{0.2}{s+0.2}} \Bigg\} + \frac{1.4}{s+0.2} = \frac{\frac{1.4}{s+0.2}}{\frac{s}{s+0.2}} = \frac{1.4}{s}$$

$$\frac{C}{T_d} = \frac{\frac{1}{s+0.2}}{1 - \frac{0.2}{s+0.2}}$$

حلقه بسته با K_t

$$\frac{C}{R} = \frac{\frac{0.4}{s+0.2}}{1 - \frac{0.2}{s+0.2}} = \frac{0.4}{s} = \frac{0.4}{s-0.4}$$

$$\frac{C}{T_d} = \frac{\frac{1}{s+0.2}}{1 - \frac{1}{s+0.2} \times \frac{0.5}{1+0.5} \times 0.4} = \frac{\frac{1}{s+0.2}}{1 - \frac{0.4}{s+0.2}} = \frac{1}{s-0.4}$$

$$\Bigg\} + \frac{1.4}{s-0.4}$$

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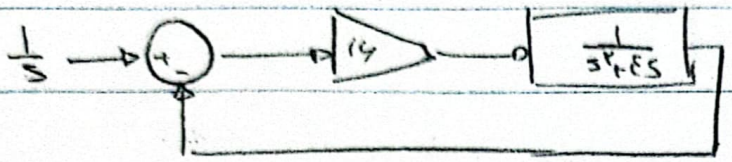
۳- الف)

$q(t) \rightarrow \frac{1}{s}$



$$T(s) = \frac{\frac{16}{s^2+4s}}{1+\frac{16}{s^2+4s}} = \frac{\frac{16}{s^2+4s}}{\frac{s^2+4s+16}{s^2+4s}} = \frac{16}{s^2+4s+16}$$

ب) مقدار حالت ماندگار

$$K_p = \lim_{s\to 0} T(s) = \lim_{s\to 0} \frac{16}{s^2+4s+16} = \frac{16}{16} = 1 \qquad \frac{1}{1+K_p}$$

خطای حالت ماندگار $\rightarrow \frac{1}{1+1} = \frac{1}{2}$

$2\xi\omega_n = 4 \rightarrow 2\times\xi\times 4 = 4 \rightarrow \xi = \frac{1}{2}$

$\omega_n^2 = 16 \rightarrow \omega_n = 4$

$$M_p = e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}} = e^{\frac{-\pi/2}{\sqrt{1-\frac{1}{4}}}} = 0.16$$

$$T_s = \frac{4}{\xi\omega_n} = \frac{4}{\frac{1}{2}\times 4} = 2 \quad \text{ثانیه}$$

ج)

$$M_P = 0.05 = e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}} \rightarrow \frac{\ln(0.05)}{-3} = \frac{\pi\xi}{\sqrt{1-\xi^2}}$$

$$\frac{\xi^2}{1-\xi^2} = 0.9025 \rightarrow \xi^2 = 0.9025 - 0.9025\xi^2$$

$$\frac{\xi}{\sqrt{1-\xi^2}} = 0.95 \rightarrow \xi = 0.707$$

$$\xi^2 = 0.5 \rightarrow \xi = 0.707$$

$$T(s) = \frac{K}{s^2+4s+K} \qquad 2\xi\omega_n = 4 \rightarrow 2\times 0.707\times\omega_n = 4 \rightarrow \omega_n = 2.9$$

$$\rightarrow K = \omega_n^2 = 8.41$$

د) مثلث

$K = 4 \rightarrow \frac{4}{s^2+4s+4}$

$$M_p = e^{\frac{-\pi}{0}} = e^{-\infty}$$

$2\xi\omega_n = 4 \rightarrow 2\times 0.5\times\omega_n = 4 \rightarrow \omega_n = 4$

$\omega_n^2 = 16$

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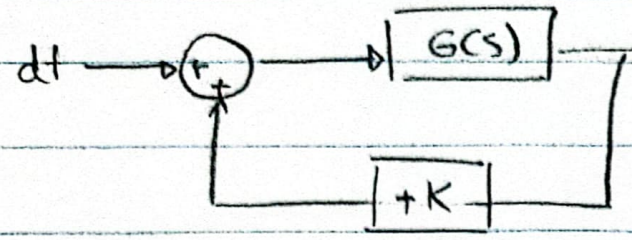
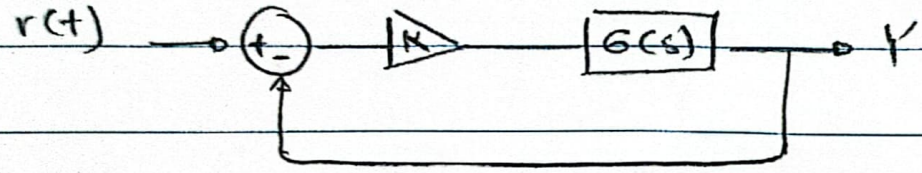


$$T(s) = \frac{G(s)}{1 - KG(s)} \qquad K_p = \lim_{s \to 0} T(s) = \lim_{s \to 0} \frac{G(s)}{1 - KG(s)} = A$$

خطای ماندگار: $\frac{1}{1+A} = B$



$$H(s) = \frac{KG(s)}{1 + KG(s)} \qquad K_p = \lim_{s \to 0} H(s) = \lim_{s \to 0} \frac{KG(s)}{1 + KG(s)} = C$$

خطای ماندگار: $\frac{1}{1+C}$

$T(s) + H(s) =$