OTOMATİK KONTROL – II Bahar 2023 VİZE SINAVI YANITLARI

1.)

a) $E(s) = R(s) - C(s)$

$$C(s) = \frac{E(s).5K.(s+3)}{s^2+2s}$$

$$E(s) = R(s) - \frac{E(s).5.K.(s+1)}{s^2+2s}$$

$$E(s)\left[1 + \frac{5K(s+1)}{s^2+2s}\right] = R(s)$$

$$E(s) = \frac{R(s)}{1 + \frac{5K(s+1)}{s^2+2s}}$$

1 soru devamı...

b) $e(\infty) = \lim_{s \to 0} \dfrac{s \cdot \frac{1}{s^2}}{1 + \frac{5K(s+3)}{s(s+2)}}$

$e(\infty) = \lim_{s \to 0} \dfrac{\frac{1}{s^2}}{\frac{s^2+2s+5Ks+15K}{s^2(s+2)}}$

$e(\infty) = \lim_{s \to 0} \dfrac{s^2+2}{s^2+(5K+2)s+15K} = \dfrac{2}{15K}$

$\dfrac{2}{15K} > 0{,}5 \Rightarrow \dfrac{2}{7{,}5} > K \;,\; K < \dfrac{4}{15}$

$\dfrac{2}{15K} < 1 \Rightarrow \dfrac{2}{15} < K \;,\; K > \dfrac{2}{15}$

2)

$$G_i(s) = \frac{G(s)}{1 + G(s).H(s) - G(s)}$$

$$G_i(s) = \frac{50.(s+3)/s^2+2s}{1 + \frac{50(s+3)}{s^2+2s} \cdot \frac{2}{s+5} - \frac{50.(s+3)}{\frac{s^2+2s}{(s+5)}}}$$

$$G_i(s) = \frac{\frac{50.(s+3)}{s^2+2s}}{\frac{(s^2+2s).(s+5) + 100(s+3) - 50.(s+3).(s+5)}{(s^2+2s).(s+5)}}$$

$$G_i(s) = \frac{50(s+3).(s+5)}{s^3+5s^2+2s^2+10s+100s+300-50s^2-400s-750}$$

Birim basamak girişi uygulanırsa:

$$e(\infty) = \lim_{s \to 0} \frac{1}{1 + G_i(s)}$$

$$\lim_{s \to 0} G_i(s) = \frac{50 \times 3 \times 5}{300 - 750} = \frac{150 \times 5}{-450} = \frac{-5}{3}$$

$$e(\infty) = \frac{1}{1 - \frac{5}{3}} = -\frac{3}{2}$$

3)

$M_p = 0,21$

$0,21 = e^{\frac{-3,14.\xi}{\sqrt{1-\xi^2}}} \Rightarrow \ln(0,21) = \frac{-3,14.\xi}{\sqrt{1-\xi^2}}$

(grafik)

$-1,56.\sqrt{1-\xi^2} = -3,14.\xi$ (Her iki tarafın karesini alalım)

$2,43.(1-\xi^2) = 9,87.\xi^2$

$2,43 - 2,43\xi^2 = 9,87\xi^2$

$2,43 = 12,3\xi^2$

$\xi^2 = 0,197$

$\xi = 0,44$.

$\frac{C(s)}{R(s)} = \frac{A}{Bs^2+s+A}$ (Karalle hale getiralim!)

$\frac{C(s)}{R(s)} = \frac{A/B}{s^2+\frac{1}{B}s+\frac{A}{B}}$

Sablon trf fonk

$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2+2.\xi.\omega_n s+\omega_n^2}$

$t_p = \frac{\pi}{\omega_d} \Rightarrow 2,81 = \frac{3,14}{\omega_d}$ $\omega_d = 1,12$ rad/s

↓ grafik

$\omega_d = \omega_n.\sqrt{1-\xi^2}$

$1,12 = \omega_n.\sqrt{1-0,44^2}$

$\omega_n = \frac{1,12}{0,893} = 1,24$ rad/s.

$t_s = \frac{4}{\xi.\omega_n} = \frac{4}{0,44.1,24} = 6,42$sn.

3 sorunun devamı...

$$\frac{A}{B} = \omega_n^2 \Rightarrow \frac{A}{B} = 1.54$$

$$\frac{1}{B} = 2\omega_n\zeta \Rightarrow \frac{1}{B} = 1.09 \quad B = 0.91$$

$$\frac{A}{0.91} = 1.54 \Rightarrow A = 1.41$$

$$\frac{C(s)}{R(s)} = \frac{1.41}{0.91s^2 + 1.09s + 1.41}$$