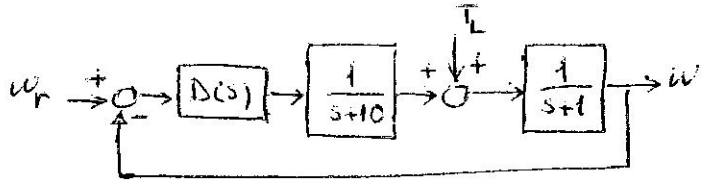
Otomatik Kontrol Yıl-içi Sınavı

12/04/2000

S.1



i) Şekilde verilen kontrol sisteminde $w=f(w_r, T_L)$ elde ediniz. (15)

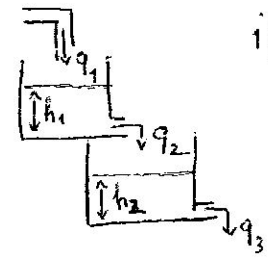
ii) T_L, bozucu girişe karşı, $D(s)=5$ ve $T_L(s)=\frac{1}{s}$ için $w(\infty)$ elde ediniz. (15)

iii) Bozucu giriş $T_L(s)=\frac{1}{s}$ için, $w_{T_L}(\infty)=0$ olabilmesi için D(s) nasıl seçilmelidir? (10)

S.2

$q_2=k_1h_1$

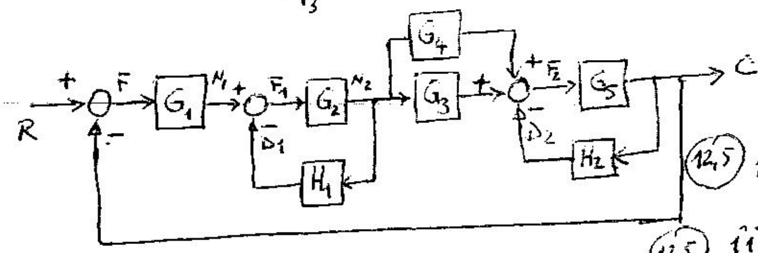
$q_3=k_2h_2$



i) Şekilde verilen sistemde $\frac{H_2(s)}{Q_1(s)}$ elde ediniz. (20)

ii) Transfer fonksiyonunu standart II. dereceden forma dönüştürünüz. ζ ve w_n'i k_1, k_2, A_1, A_2 cinsinden elde ediniz. (15)

S.3



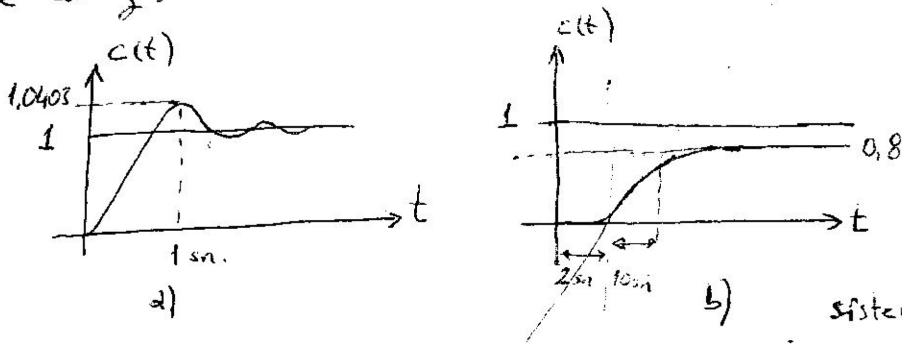
$\frac{C(s)}{R(s)}$ transfer fonksiyonunu

(12,5) i) Blok-diyagram indirgeme ve

(12,5) ii) Mason kazanç formülünü kullanarak

elde ediniz.

S.4



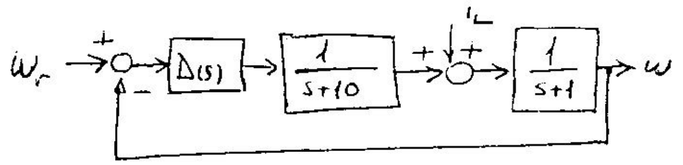
Şekil a) ve b)'de sırası ile birim basamak giriş için II. dereceden ve ölü zamanlı I. dereceden sistem cevapları verilmiştir.

(7,5) i) Her iki sistem için genel ifadeleri yazınız. (transfer fonksiyonlarını yazınız.)

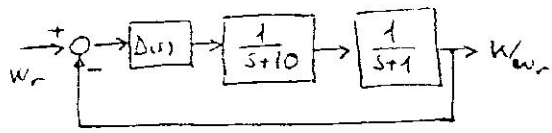
(7,5) ii) Transfer fonksiyonlarındaki parametre değerlerini ilgili cevap eğrilerinden elde ediniz.

Başarılar süre 90 dak.

(1)

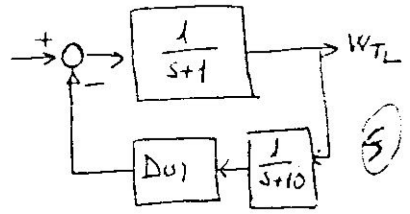


1) i) $T_L = 0$ için W_{w_r}



$$\frac{W_{w_r}}{W_r} = \frac{\frac{D(s)}{(s+1)(s+10)}}{1+\frac{D(s)}{(s+1)(s+10)}} \Rightarrow \boxed{\frac{W_{w_r}}{W_r} = \frac{D(s)}{(s+10)(s+1)+D(s)}}$$ 5

ii) $W_r = 0 \Rightarrow$



5

$$\frac{w_{T_L}}{T_L} = \frac{\frac{1}{s+1}}{1+\frac{D(s)}{(s+1)(s+10)}} \Rightarrow$$

$$\frac{W_{T_L}}{T_L} = \frac{s+10}{(s+1)(s+10)+D(s)}$$

$W = f(W_r, T_L)$ isteniyor ise i) ve ii) denk. düzenlenir ise,

$$W = W_{w_r} + W_{T_L} \Rightarrow \boxed{W = \frac{D(s)}{(s+10)(s+1)+D(s)}\, w_r + \frac{(s+10)}{(s+10)(s+1)+D(s)}\, T_L}$$ 5

---

2) $D(s) = 5$ ve $T_L(s) = \frac{1}{s} \Rightarrow$ $w_{T_L} = \frac{s+10}{(s+1)(s+10)+D(s)} T_L \Rightarrow w_{T_L}(\infty) = \lim_{s\to 0} \cancel{s} \cdot \frac{s+10}{(s+1)(s+10)+D(s)} \cdot \frac{1}{\cancel{s}} \Rightarrow$ 3

$$W_{T_L}(\infty) = \frac{10}{10+5} \Rightarrow \boxed{W_{T_L}(\infty) = 0{,}6667}$$ 2

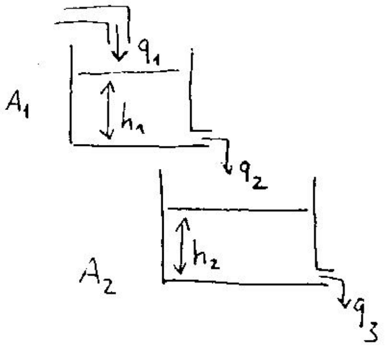
3) $D(s) = \frac{1}{s}$ seçilir ise (en basit olarak) $w_{T_L} = \frac{s+10}{(s+1)(s+10)+\frac{1}{s}} \cdot T_L(s) \Rightarrow$ 3

$$W_{T_L} = \frac{(s+10).s}{s(s+1)(s+10)+1} T_L(s) \Rightarrow w_{T_L}(\infty) = \lim_{s\to 0} s \cdot \frac{s(s+10)}{s(s+1)(s+10)+1} \cdot \frac{1}{s} \Rightarrow$$ 2

$$\boxed{W_{T_L}(\infty) = 0}$$ 1

(2)

i)



Verilenler

$q_2 = k_1 h_1$

$q_3 = k_2 h_2$

$q_1 - q_2 = A_1 \frac{dh_1}{dt} \Rightarrow Q_1(s) - Q_2(s) = A_1 s H_1(s)$

$Q_2(s) = K_1 H_1(s)$

$q_3 - q_2 = A_2 \frac{dh_2}{dt}$

$Q_1(s) = H_1(s)[A_1 s + K_1] \Rightarrow$

(1) $$\boxed{\frac{H_1(s)}{Q_1(s)} = \frac{1}{A_1 s + K_1}}$$

$Q_3(s) - Q_2(s) = A_2 s H_2(s)$

$K_2 H_2(s) - Q_2(s) = A_2 s H_2(s) \Rightarrow Q_2(s) = K_2 H_2(s) + A_2 s H_2(s) \Rightarrow$

(2) $$\boxed{\frac{H_2(s)}{Q_2(s)} = \frac{1}{A_2 s + K_2}}$$

istenen : $\frac{H_2(s)}{Q_1(s)} = ?$

$Q_2(s) = k_1 H_1(s)$ → (1) nolu denklemden $H_1(s)$ elde edilir.

$Q_2(s) = k_1 \cdot \frac{Q_1}{A_1 s + K_1}$ bu denklem (2) nolu denklemde yerine koyulursa

$$\frac{H_2(s)}{\frac{k_1 Q_1(s)}{A_1 s + K_1}} = \frac{1}{A_2 s + K_2} \Rightarrow \frac{H_2(s)}{Q_1(s)} \cdot \frac{A_1 s + K_1}{K_1} = \frac{1}{A_2 s + K_2} \Rightarrow$$

$$\boxed{\frac{H_2(s)}{Q_1(s)} = \frac{K_1}{(A_1 s + K_1)(A_2 s + K_2)}}$$

ii)

$$\frac{H_2(s)}{Q_1(s)} = \frac{K_1}{A_1 A_2 s^2 + A_1 K_2 s + K_1 A_2 s + K_1 K_2} = \frac{K_1}{A_1 A_2 s^2 + (A_1 K_2 + K_1 A_2) s + K_1 K_2}$$

$$= \frac{\frac{K_1}{A_1 A_2}}{s^2 + \frac{(A_1 K_2 + K_1 A_2)}{A_1 A_2} s + \frac{K_1 K_2}{A_1 A_2}}$$

standart forma dönüştürülürse,

$$\frac{H_2(s)}{Q_1(s)} = \frac{1}{K_2} \cdot \frac{\frac{K_1 K_2}{A_1 A_2}}{s^2 + \left(\frac{A_1 K_2 + K_1 A_2}{A_1 A_2}\right) s + \frac{K_1 K_2}{A_1 A_2}} \triangleq \frac{w_n^2}{s^2 + 2\zeta w_n s + w_n^2} \cdot \frac{1}{K_2} \Rightarrow$$

$w_n^2 = \frac{K_1 K_2}{A_1 A_2} \Rightarrow$

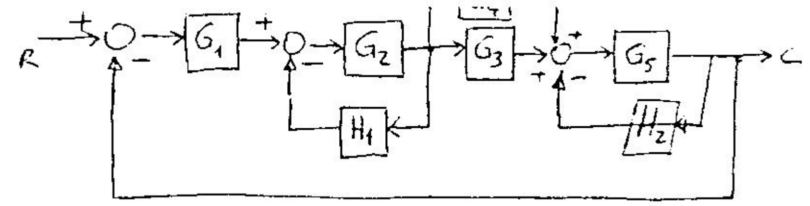
$$\boxed{w_n = \sqrt{\frac{K_1 K_2}{A_1 A_2}}}$$

$2\zeta w_n = \left(\frac{A_1 K_2 + K_1 A_2}{A_1 A_2}\right) \Rightarrow$

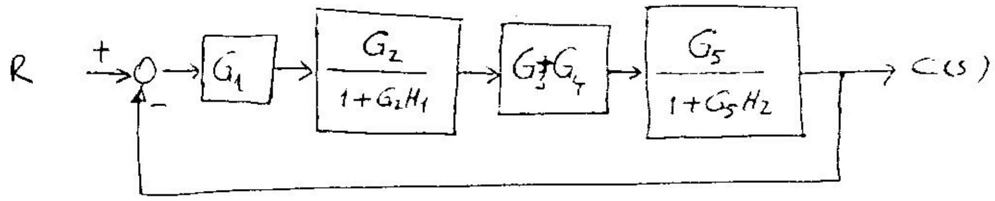
$\zeta = \left(\frac{A_1 K_2 + K_1 A_2}{A_1 A_2}\right) \sqrt{\frac{A_1 A_2}{K_1 K_2}} \cdot \frac{1}{2}$

$$\boxed{\zeta = \frac{1}{2} \sqrt{\frac{1}{A_1 A_2 K_1 K_2}} (A_1 K_2 + K_1 A_2)}$$

(3)



i) Blok-diyagram indirgeme:



$$\frac{C(s)}{R(s)} = \frac{\dfrac{G_1(s)G_2(s)G_5(s)\{G_3(s)+G_4(s)\}}{[1+G_2(s)H_1(s)][1+G_5H_2]}}{1+\dfrac{G_1G_2G_5(s)\{G_3(s)+G_4(s)\}}{[1+G_2(s)H_1(s)][1+G_5H_2(s)]}} = \frac{G_1G_2G_5\{G_3(s)+G_4(s)\}}{1+G_2H_1(s)+G_1G_2G_5G_3(s)+G_1G_2G_5G_4(s)+G_5H_2+G_2G_5H_1H_2}$$

ii) Mason Kazancı formülü ile.

döngüler (tekli).

$L_1 = -G_2H_1$

$L_2 = -G_5H_2$

$L_3 = -G_1G_2G_3G_5$

$L_4 = -G_1G_2G_4G_5$

ileri-yollar

$P_1 = G_1G_2G_3G_5$

$P_2 = G_1G_2G_4G_5$

temas etmeyen üçlü veya dörtlü döngüler yok.

$\Delta = 1-(L_1+L_2+L_3+L_4)+L_1L_2$

$\Delta = 1+G_2H_1+G_5H_2+G_1G_2G_3G_5+G_1G_2G_4G_5+G_2G_5H_1H_2$

$\Delta_1 = 1$

$\Delta_2 = 1$

temas etmeyen ikili çevrimler

$L_1L_2 = G_2G_5H_1H_2$

$$T = \frac{P_1\Delta_1+P_2\Delta_2}{\Delta} = \frac{\overbrace{G_1G_2G_3G_5+G_1G_2G_4G_5}^{G_1G_2G_5(G_3+G_4)}}{1+G_2H_1+G_5H_2+G_1G_2G_3G_5+G_1G_2G_4G_5+G_2G_5H_1H_2}$$

i) ve ii) sonuçları aynıdır