ÖRNEK 1 | RLC Devresi

$$L\frac{di}{dt} = V_L$$

$$-V + V_L + V_R + V_C = 0$$

$$L\frac{di(t)}{dt} + Ri(t) + \frac{1}{C}\int i(t)\,dt = V_R$$

$$L\frac{d^2i(t)}{dt^2} + R\frac{di(t)}{dt} + \frac{1}{C}i(t) = 0$$

$$LC\frac{d^2i(t)}{dt^2} + RC\frac{di(t)}{dt} + i(t) = 0$$

$x_1(t) = i(t) \qquad x_2(t) = \frac{di(t)}{dt}$

$$\frac{dx_1(t)}{dt} = x_2(t) \quad (1)$$

$$LC\frac{d^2x_1(t)}{dt^2} + RC\frac{dx_1(t)}{dt} + x_1(t) = V_L$$

$$\frac{dx_2(t)}{dt} = -\frac{R}{L}\underbrace{\frac{dx_1(t)}{dt}}_{x_2(t)} - \frac{1}{LC}x_1(t) \quad (2)$$

$$\begin{bmatrix} \frac{dx_1(t)}{dt} \\ \frac{dx_2(t)}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\frac{1}{LC} & -\frac{R}{L} \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{LC} \end{bmatrix} V_L$$

Lineer olmayan Sistem için Durum Denklemi

$$\frac{dx(t)}{dt} = f(x(t)) + g(x(t))\,u(t)$$

Statik Sistemde gecikme yoktur. (R)
Dinamik sistem → herhangi bir. andaki değeri o ana yada geçmişteki bir ana bağlı olan sistemler (LC)

$$E(t) = L\frac{di(t)}{dt} + Ri(t) + \frac{1}{C}\int i(t)\,dt$$

$$V_o(t) = \frac{1}{C}\int i(t)dt = V_c(t)$$

$$E(s) = LsI(s) + RI(s) + \frac{1}{Cs}I(s)$$

$$I(s)\left\{Ls + R + \frac{1}{Cs}\right.$$

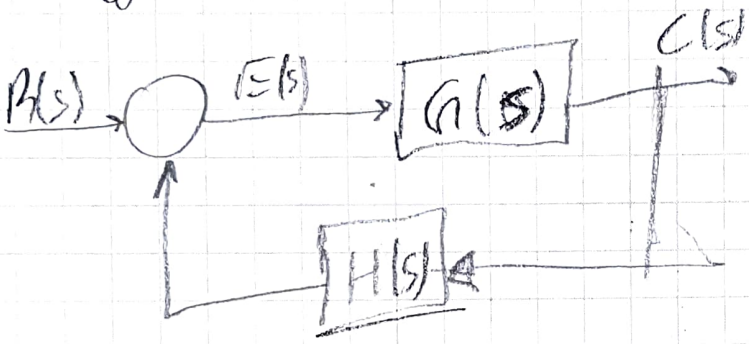
$$V_o(s) = \frac{1}{Cs}I(s)$$

$$F(s) = L\{f(t)\} = \int_0^\infty f(t)e^{-st}dt$$

$$\text{Kalıntı} = \lim_{s\to \text{kutup}}\left[(s - \text{kutup})F(s)e^{st}\right]$$

$$f(t) = \sum_{i=1}^{n} \frac{1}{(m-1)!}\frac{d^{m-1}}{ds^{m-1}}\left[(s-s_i)^m F(s)e^{st}\right]$$

SAYFA 53



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

$$C(s) = E(s)\,G(s)$$

$$C(s) = R(s)\,G(s) - C(s)H(s)\,G(s)$$

$$C(s)\left[1 + G(s)H(s)\right] = R(s)G(s)$$

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 + G(s)H(s)}$$

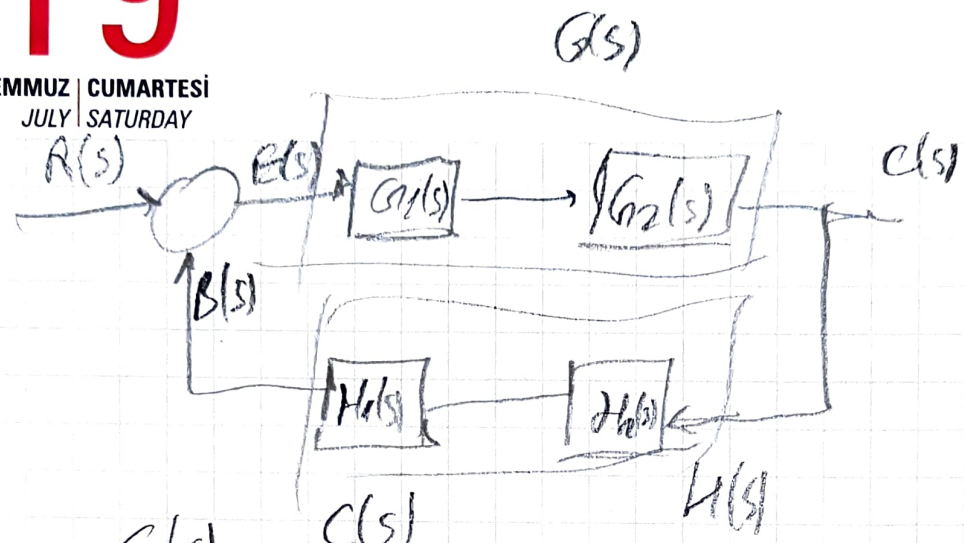
$G(s)$ → İleriyol Transfer Fak → Negatif geri beslemeli (+)

$1 + G(s)H(s)$ → geriyol Trans fonk

19

TEMMUZ | CUMARTESİ
JULY | SATURDAY

TEMMUZ 2014							
H	P	S	Ç	P	C	Ct	Pz
27		1	2	3	4	5	6
28	7	8	9	10	11	12	13
29	14	15	16	17	18	19	20
30	21	22	23	24	25	26	27
31	28	29	30	31			



$$G_1(s) = \frac{C(s)}{E(s)}$$

$$H(s) = \frac{B(s)}{C(s)}$$

$$G(s) = G_1(s) \cdot G_2(s)$$

$$H(s) = H_1(s) \cdot H_2(s)$$

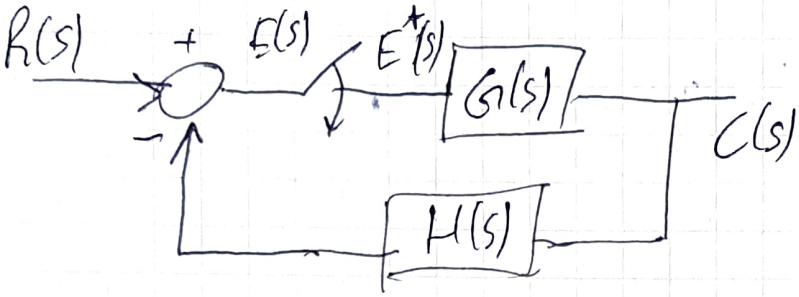
20

TEMMUZ | PAZAR
JULY | SUNDAY

Ters Laplace Dönüşümü ÖRNEK-1
Rezidü hesabında kök-2 için
HATA SAYFA 26

~~0+x-b=0~~ $\quad U-b=X$

SAYFA 56



$$\frac{C^*(s)}{R^*(s)} = ? = \frac{C(z)}{R(z)}$$

① $E(s) = R(s) - C(s)H(s)$

② $C(s) = E^*(s)\,G(s)$

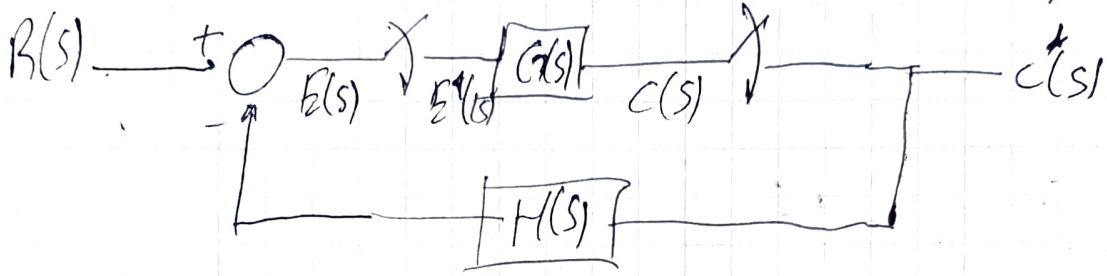
$$E(s) = R(s) - E^*(s)\underbrace{G(s)H(s)}_{GH^*(s)}$$

$$E^*(s) = \frac{R^*(s)}{1+GH^*(s)} \longrightarrow C^*(s) = E^*(s)\,G^*(s)$$

$$C(z) = \frac{G(z)}{1+GH(z)}\,R(z)$$

TMMOB MAKİNA MÜHENDİSLERİ ODASI

SAYFA (57)



① $E(s) = R(s) - C^*(s) H(s)$

② $C(s) = E^*(s) G^*(s)$

$E^*(s) = R^*(s) - E^*(s) G^*(s) H^*(s)$

$E(z) = R(z) - E(z) G(z) H(z)$

$E(z) = \dfrac{R(z)}{1 + G(z)H(z)}$ $\qquad C(z) = \dfrac{G(z)}{1+G(z)} R(z)$

SAYFA (58)

$H(s) = U^*(s) G_2(s)$

$H^*(s) = U^*(s) G_2^*(s)$

$U(s) = Y^*(s) D(s)$

$U^*(s) = Y^*(s) D^*(s)$

$Y(s) = X(s) G_1(s)$

$Y^*(s) = X G_1^*(s)$

$H^*(s) = G_2^*(s) D^*(s) X G_1^*(s)$

$H(z) = G_2(z) D(z) X G_1(z)$

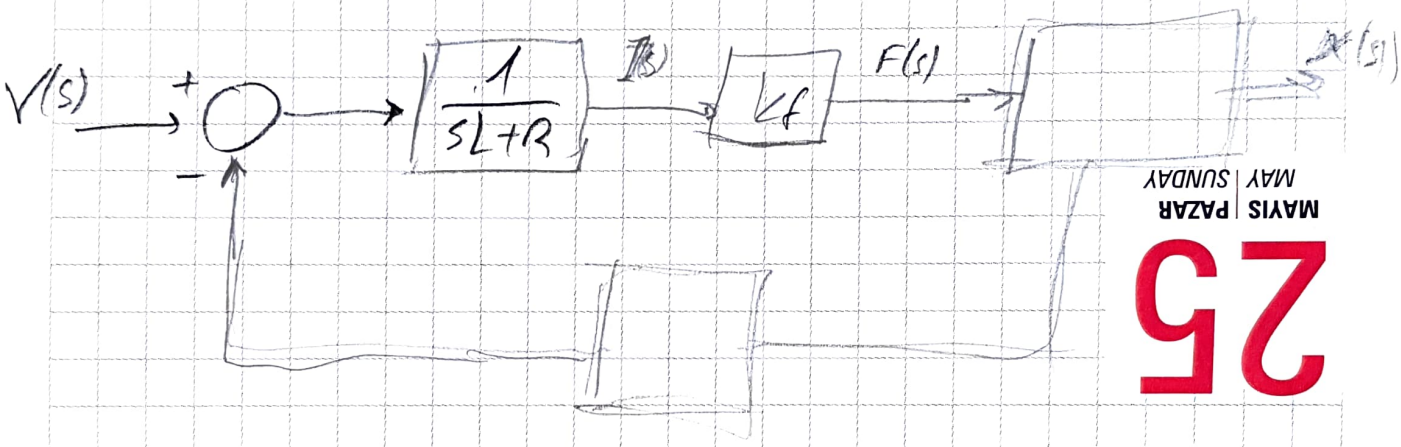
SAYFA 63

$$V(s) = R\,I(s) + sL\,I(s) + E(s)$$

$$I(s) = \frac{V(s) - E(s)}{sL + R}$$

$$F(s) = k_t\, I(s)$$

$$F(s) = m s^2 X(s) + B s X(s) + k X(s)$$



SAMFA (6)

① $e(t) = K_\phi (f_r - f_w)$

② $e_c(t) = e_a(t) . Filtre$

③ $e_a(t) = K\, e_c(t)$

④ $e_a(t) = RI(t) + e_b(t)$

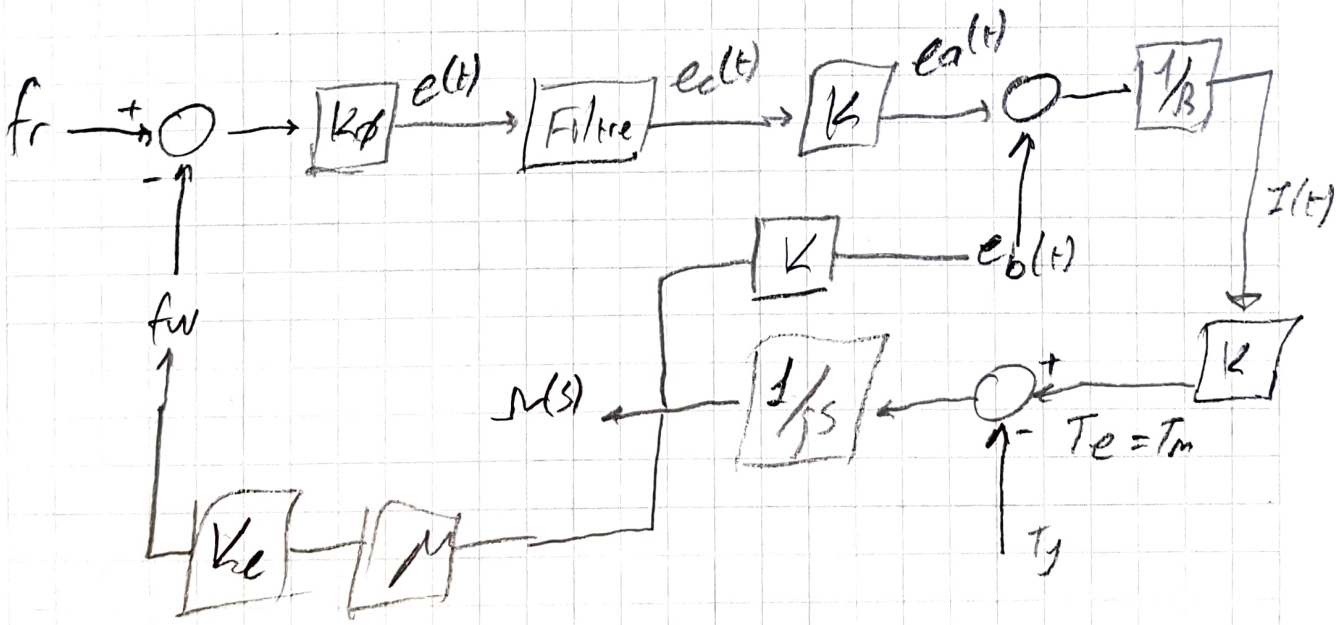
⑤ $\boxed{e_b(t) = k_w w(t)}$

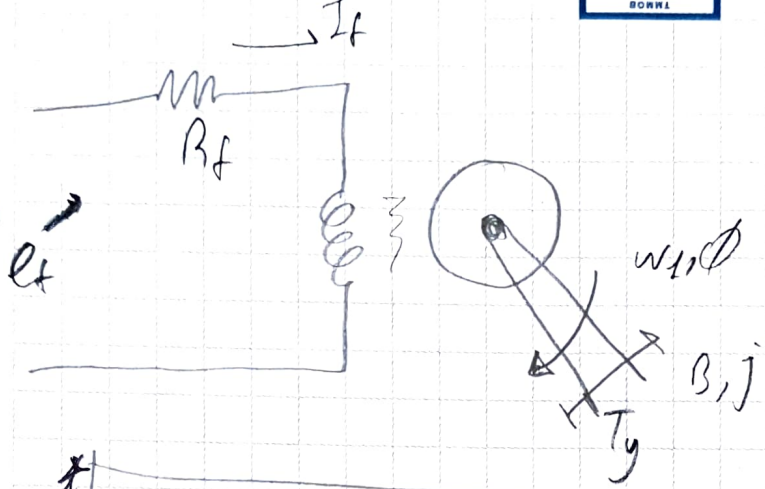
⑥ $\boxed{T_e(t) = K\, I(t)}$

⑦ $\boxed{T_m(t) = T_e(t)}$

⑧ $T_m(t) = J \frac{d w(t)}{dt} + T_y$

⑨ $f_w = K_e N w(t)$





$$T_e(t) = K_I I_f(t)$$

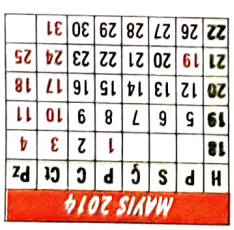
① $e(t) = R\,i(t) + L \frac{di(t)}{dt}$

② $T_e(t) = K_I I(t)$

③ $T_m(t) = J \frac{dw(t)}{dt} + B\,w(t) + T_y$

④ $T_e(t) = T_m(t)$ ⟶ sürekli rejimde elektriksel moment mekanik momente eşit

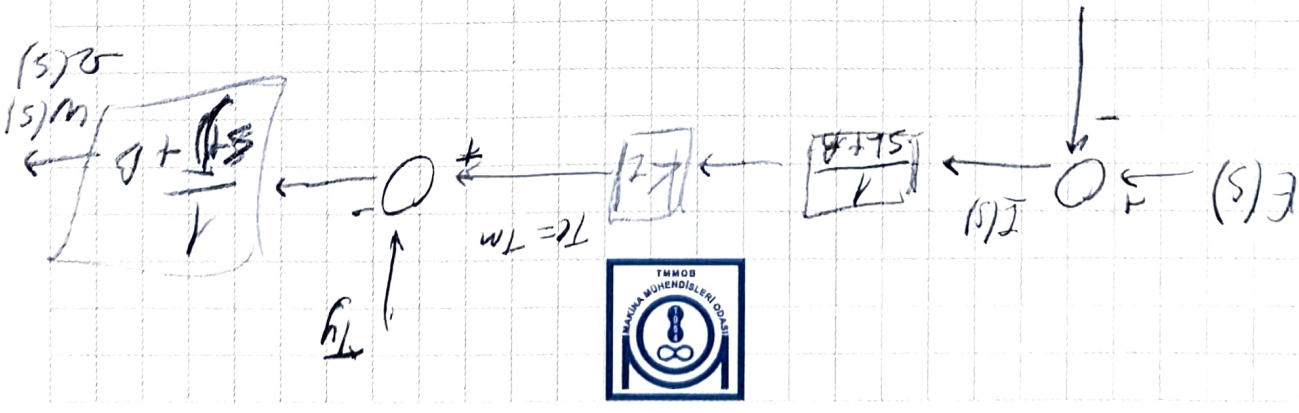
$$E(s) = R\,I(s) + s\,L\,I(s)$$
$$T_e(s) = K_I I(s)$$
$$T_m(s) = s\,J\,\Omega(s) + B\,\Omega(s) + T_y(s)$$
$$T_e(s) = T_m(s)$$



MAYIS 2014							
H	P	S	Ç	P	C	Ct	Pz
18				1	2	3	4
19	5	6	7	8	9	10	11
20	12	13	14	15	16	17	18
21	19	20	21	22	23	24	25
22	26	27	28	29	30	31	

21

MAYIS | **ÇARŞAMBA**
MAY | *WEDNESDAY*



SAYFA 68

① $e(t) = RI(t) + L\frac{dI(t)}{dt}$

② $Te(t) = K\,I(t)$

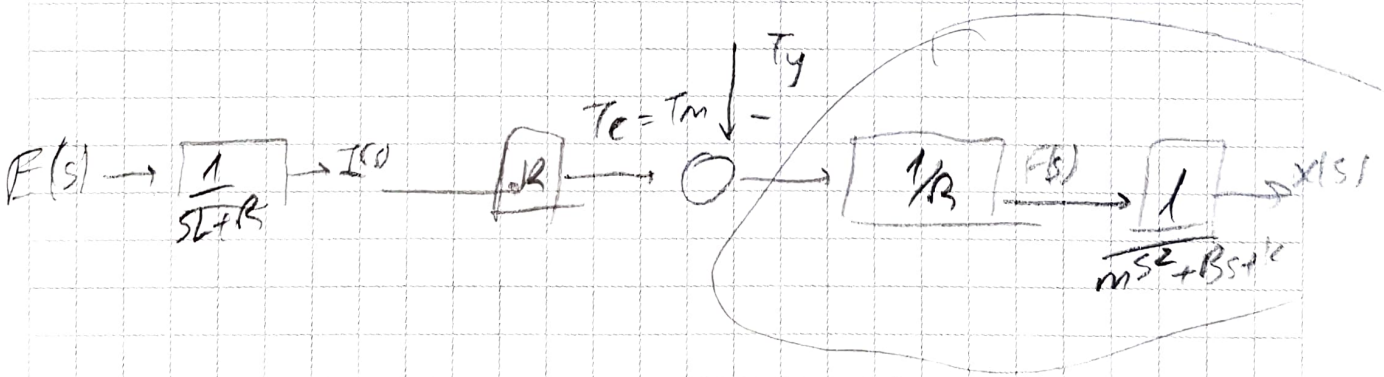
③ $Tm(t) = J\frac{dw(t)}{dt} + Bw(t) + Tyük(t)$

④ $Te(t) = Tm(t)$

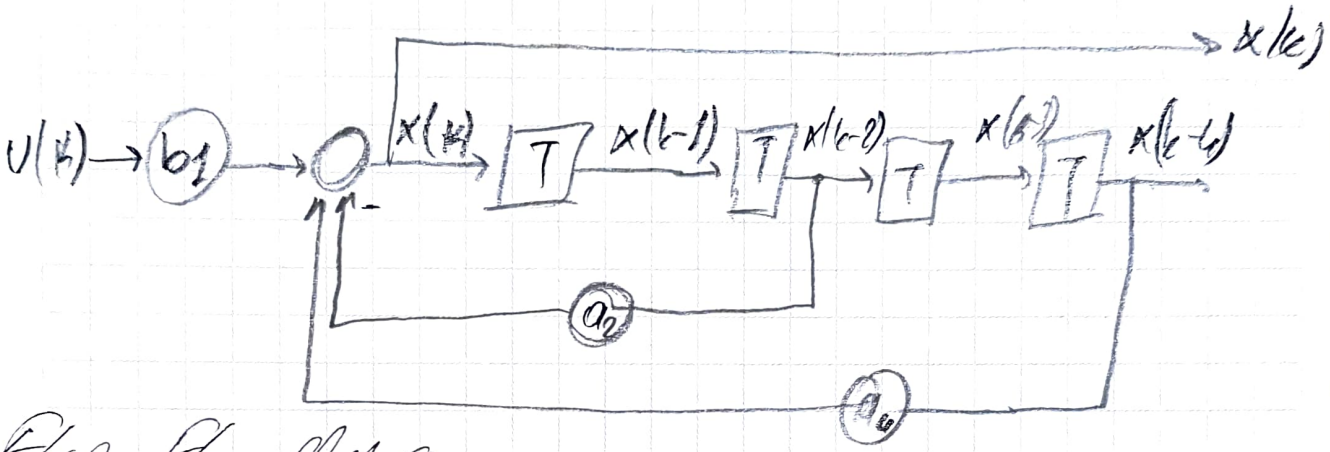
⑤ $Tyük(t) = F(t)\,r$

⑥ $m \cdot a = Fnet = F(t) - [F_1 + F_2]$

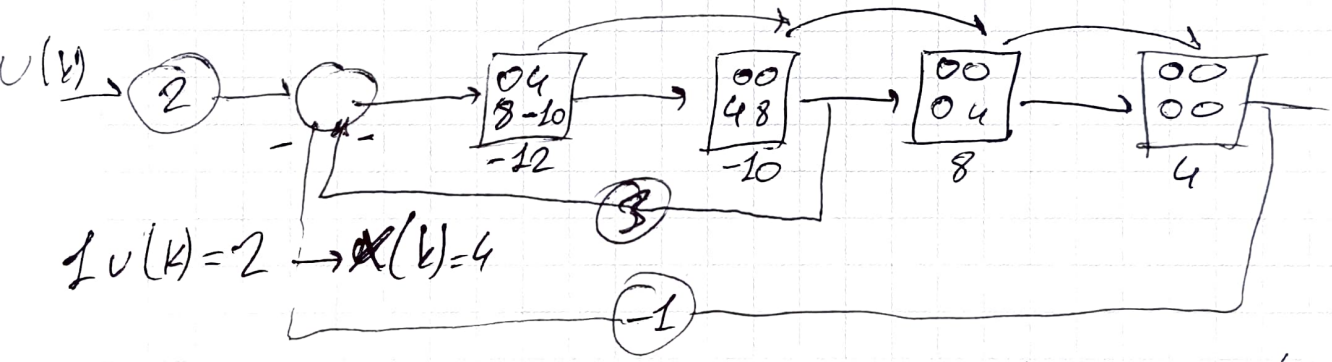
$$m\frac{d^2x(t)}{dt^2} = F(t) - kx(t) - B\frac{dx(t)}{dt}$$



5.93 $x(k) = b_1 u(k) - a_2 x(k-2) - a_4 x(k-4)$



Flop-Flop Montaj



$1\,u(k) = 2 \rightarrow x(k) = 4$

2 2
4

$1\,u(k) = 2 \Longrightarrow x(k) = 4$

$2\,u(k) = 4 \rightarrow x(k) = 8$

$3\,u(k) = 6 \rightarrow x(k) = -10$

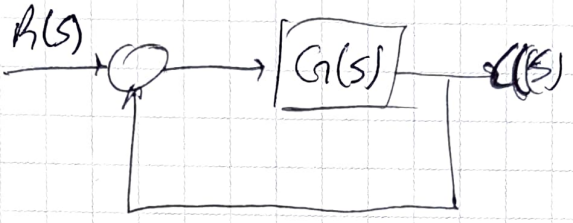
$4\,u(k) = 6 \rightarrow x(k) = -12$

$\Delta = b^2 - 4ac$

$x_{1,2} = \frac{-b \mp \sqrt{\Delta}}{2a}$

@r0 @r1 (2) #02H

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2} = \frac{G(s)}{1 + G(s)} = \frac{\frac{\omega_n^2}{s^2 + 2\xi\omega_n s}}{1 + \frac{\omega_n^2}{s^2 + 2\xi\omega_n s}}$$



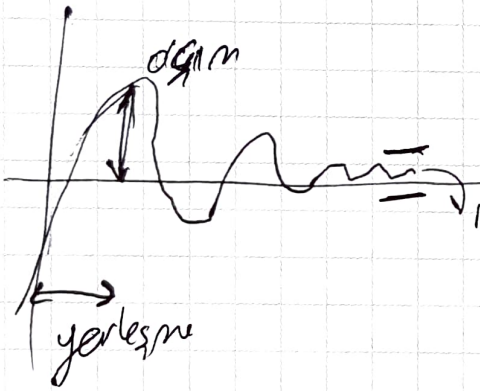
Birim geribeslene

$s^2 + 2\xi\omega_n s + \omega_n^2 = 0$ → Karakteristik Denklem

$0 < \xi < 1$

$s_{1,2} = -\xi\omega_n \mp \omega_n\sqrt{\xi^2 - 1}$

$s_{1,2} = -\xi\omega_n \mp \omega_n j\sqrt{1 - \xi^2}$ (kompleks)



İstenilen değer ulaşma (Tolerans)

MART MARCH PAZAR SUNDAY 11

Aşım verilecek ise hesaplanacak / %20 → 0,2 (Mp)

$\ln 0{,}2 = \frac{-\xi}{\sqrt{1 - \xi^2}}\pi$

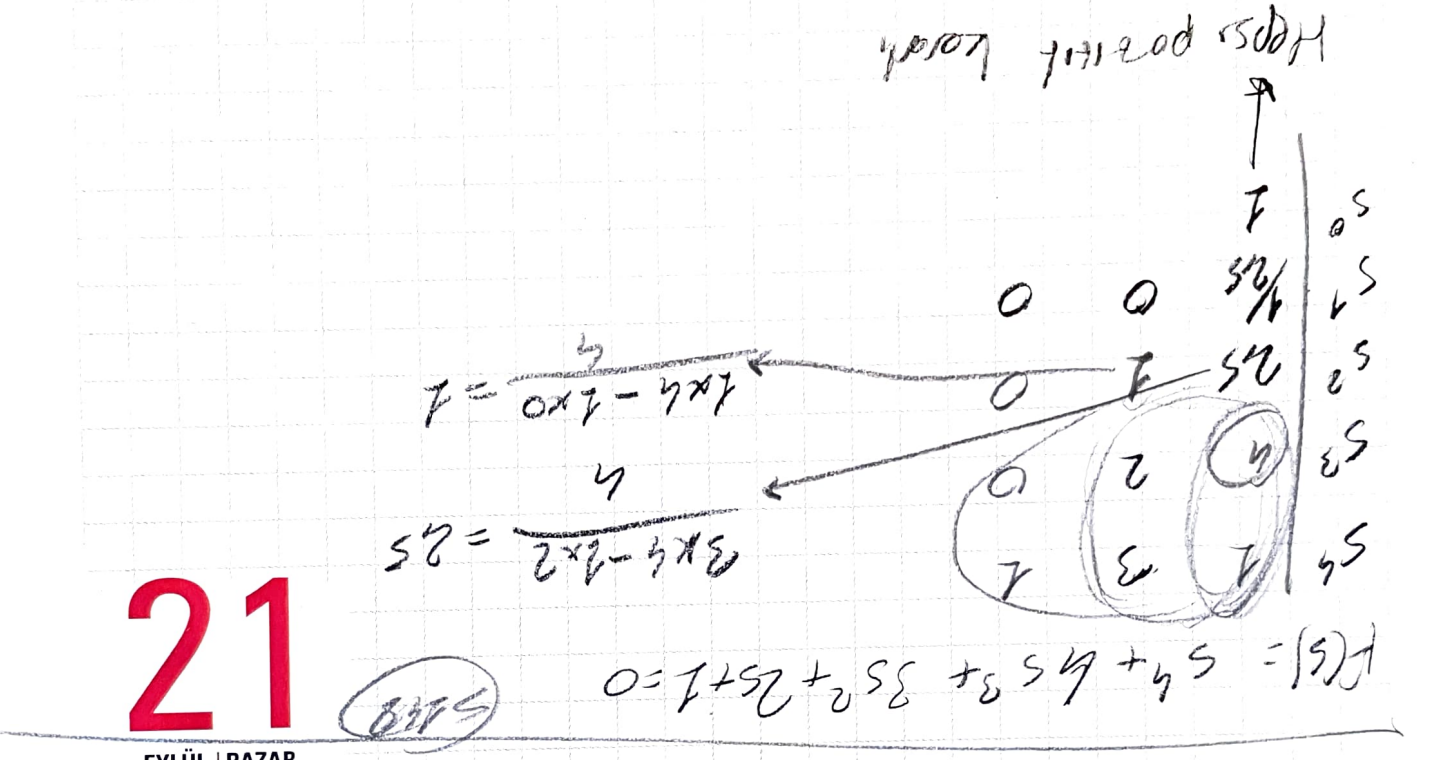
Tepe zamandan ω_n bul / (tp)

$t_{1,2} = \frac{\pi}{\omega_n\sqrt{1 - (\xi)^2}}$

TMMOB MAKİNA MÜHENDİSLERİ ODASI 1954

EYLÜL 2014

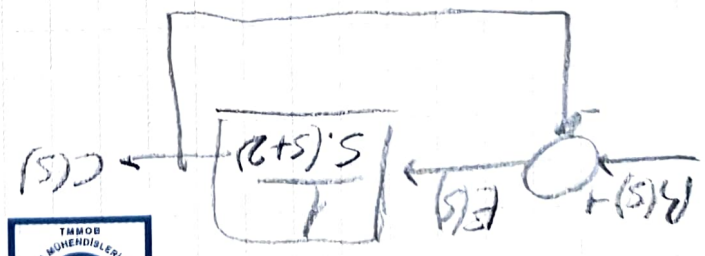
H	P	S	Ç	P	C	Ct	Pz
36	1	2	3	4	5	6	7
37	8	9	10	11	12	13	14
38	15	16	17	18	19	20	21
39	22	23	24	25	26	27	28
40	29	30					



$$K_p=\lim_{s\to0}\frac{1}{s(s+2)}=\infty$$

$$\lim_{s\to0}E(s)=\lim_{s\to0}\frac{1}{1+\frac{1}{s(s+2)}}=\frac{1}{1+\infty}=0$$

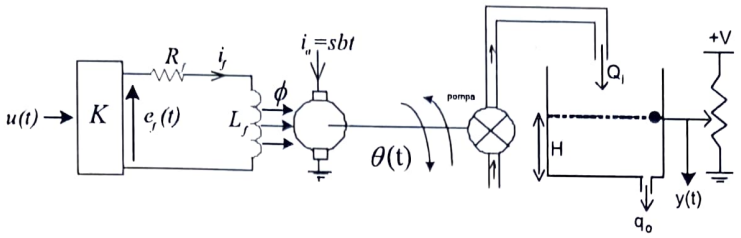
$$E(s)=\frac{R(s)}{1+G(s)}$$



11.04.2015

OTOMATİK KONTROL VİZE SINAVI

S1



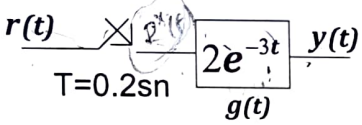
Şekilde verilen sıvı seviye kontrol sisteminde $Q_i(t)$ debisi alan kontrollü DC makinede (viskoz sürtünme, **B**=0) $\theta(t)$ açısı ile kontrol edilmektedir. Sıvı seviye sisteminde $q_o(t) = DH(t)$ ile değişmektedir.

$\left(\frac{\theta(s)}{Q_i(s)} = \frac{K_h}{\tau s+1}\right.$, $y(t) = K_p H(t)$; , $H(t) = \frac{1}{A}\int (Q_i(t) - q_o(t))dt$, **A** : Havuz taban alanı)

a) Şekilde verilen sistemin t-domein ve s-domein'e ait dinamik denklemlerini yazınız.

b) $y_r(t)$ referans giriş, $D(z)$ ayrık zaman kontrolcü, T örnekleme zamanı olmak üzere sisteme ait ayrık zaman kapalı çevrim kontrol blok diyagramını çiziniz. Her blok için transfer fonksiyonlarını yazınız.

S2



Yanda verilen sistem için, $r(t) = u(t)$ basamak giriş için;

i) $Y(z)$ ifadesini yazınız.

ii) $t = kT$ olmak üzere $Y(z)$ ifadesini t domeninden doğrudan elde ediniz.

iii) Kompleks değişkenler teorisinden rezidü yöntemini kullanarak $Y(z)$ elde ediniz.

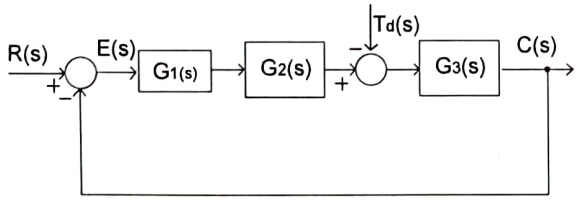
iv) Ters Z dönüşümü $y(kT) = y(k) =?$ elde ediniz.

S3 Bir sistemi tanımlayan diferansiyel denklem $\frac{d^2\theta(t)}{dt^2} + \frac{k}{m}\frac{d\theta(t)}{dt} + \frac{g}{l}\sin\theta(t) = u(t)\theta(t)$ ile verilmektedir.

a) Sisteme ait durum denklemlerini $\frac{dx(t)}{dt} = f(x(t)) + g(x(t))u(t)$ formunda yazınız.

b) $x(t) = x_0, u(t) = u_0$ çalışma noktası için sisteme ait durum denklemlerini $\frac{\Delta x(t)}{\Delta t} = A^*\Delta x(t) + B^*\Delta r(t)$ formunda elde ediniz.

S4



Yukarıda kapalı çevrim kontrol blok diyagramında;

a) C(s) çıkışını elde ediniz.

b) $G_1(s) = \frac{2}{3s+1}, G_2(s) = 10, G_3(s) = \frac{5}{0.1s+1}, Td(t) = 0.1\,u(t);\ r(t) = 2\,u(t)$ olmak üzere $c(\infty) =?$ Hesaplayınız.

Formüller

$$x(k) = \sum_{i=1}^{n} \frac{1}{(m-1)!}\frac{d^{m-1}}{dz^{m-1}}\left[(z-z_i)^m X(z) z^{k-1}\right]_{z=z_i}$$

$$X(z) = \sum_{i=1}^{n}\left\{\frac{1}{(m-1)!}\frac{d^{m-1}}{ds^{m-1}}\left[(s-s_i)^m X(s)\frac{z}{z-e^{sT}}\right]\right\}$$

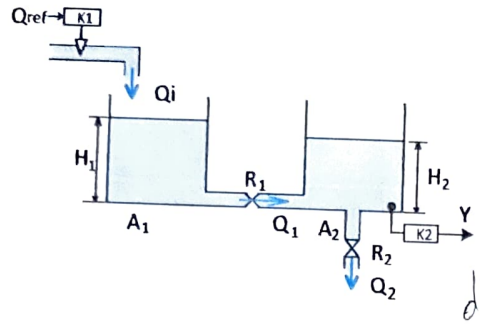
Başarılar, Süre 90 dk

Prof. Dr. Ayhan ÖZDEMİR, Yrd. Doç. Dr. Zekiye ERDEM

04.04.2018

OTOMATİK KONTROL ARA SINAVI

S-1



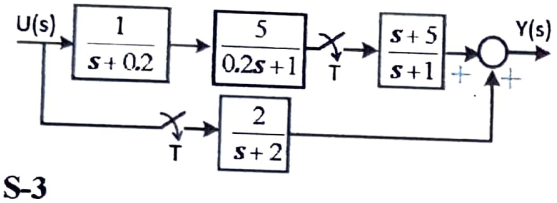
Birinci ve ikinci sıvı tanklarının taban alanları sırası ile A_1 ve A_2 dir. Debiler $Q_1 = R_1\sqrt{H_1 - H_2}$ ve $Q_2 = R_2\sqrt{H_2}$ dir.

a) Sistemin t-domeni denklemlerini yazınız.

b) Sistemin matematik modelini H_{10}, H_{20} ve Q_{10} çalışma noktaları için doğrusallaştırınız.

c) Sistemin durum denklemler vektör matris formu $\frac{\Delta x(t)}{\Delta t} = A * \Delta x(t) + B * \Delta u(t)$ olarak yazınız.

S-2



$U(s) = \frac{1}{s}$ ile verilen sistemi $T = 0.02\ sn$ için

a) $Y(z)$ elde ediniz. b) $y(k)$ ifadesini elde ediniz.

S-3

Açık çevrim transfer fonksiyonu, $G(s) = \frac{1}{(s+0.2)}$ olarak verilen sistem örnekleme zamanı $T = 1\ sn$ olmak üzere ayrık-zaman sayısal kontrolcü $D(z) = 1$ ile kontrol edilmek istenmektedir.

a) Ayrık zaman kapalı çevrim transfer fonksiyonu $T(z) = \frac{C(z)}{R(z)}$ elde ediniz.

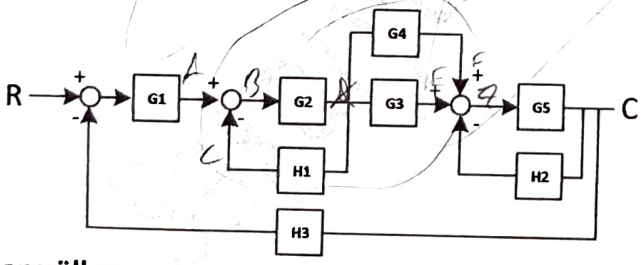
b) $r(t) = u(t)$ için $C(z) = ?$ ve $C(kT) = ?$

c) $c_{(\infty)} = \lim_{k\to\infty} c_{(k)}$ ve $c_{(\infty)} = \lim_{z\to 1}(z-1)C_{(z)}$ ifadelerinden ayrı ayrı $C(\infty)$ değerini hesaplayınız.

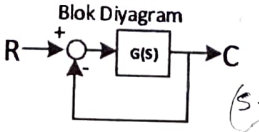
S-4

a) Aşağıda verilen blok diyagrama ait ileri yol transfer fonksiyonu (G_{ileri}), geri yol transfer fonksiyonu(G_{geri}) ve kapalı çevrim transfer fonksiyonunu ($TF = \frac{C(s)}{R(s)}$) elde ediniz.

b) Sistemin, birim geri beslemeli blok diyagramını elde ediniz.



Birim Geri Beslemeli Blok Diyagram



Formüller

$$x(k) = \sum_{i=1}^{n} \frac{1}{(m-1)!}\frac{d^{m-1}}{dz^{m-1}}\left[(z-z_i)^m X(z) z^{k-1}\right]_{z=z_i}$$

$$X(z) = \sum_{i=1}^{n}\left\{\frac{1}{(m-1)!}\frac{d^{m-1}}{ds^{m-1}}\left[(s-s_i)^m X(s)\frac{z}{z-e^{sT}}\right]_{s=s_i}\right\}$$

Başarılar, Süre 90 dak.

Prof. Dr. Ayhan ÖZDEMİR, Dr. Öğr. Üyesi. Burhan Baraklı