

Year. Month. Date. (1)

$$1) X(s) = \frac{s^3}{(s+2)^2(s+8)} \quad \left. \begin{array}{l} s_1 = 0 \\ s_2 = -2 \\ s_3 = -8 \end{array} \right\} \Rightarrow \text{Ansatz } -\frac{A}{s} - \frac{B}{s+2} - \frac{C}{s+8}$$

$$X(s) = \sum \text{Res}(X(p) \frac{1}{1-e^{-Ts-p}})$$

$$= \lim_{p \rightarrow -2} \frac{d}{dp} \left(\frac{p^3}{(p+8)^3} \frac{1}{1-e^{-Ts-p}} \right) + \lim_{p \rightarrow -8} \frac{1}{2!} \frac{d^2}{dp^2} \left(\frac{p^3}{(p+2)^2} \frac{1}{1-e^{-Ts-p}} \right)$$

$$X(s) = \frac{2}{27} \left(\frac{1}{e^{-Ts-8}-1} - \frac{1}{e^{-Ts-2}-1} \right) + \frac{I}{27} \left(\frac{-e^{-Ts-2}}{(e^{-Ts-2}-1)^2} + \frac{16e^{-Ts-8}}{2(e^{-Ts-8}-1)^2} \right)$$

$$- \frac{64T^2}{9} \left(\frac{Re^{-Ts-8}}{(e^{-Ts-8}-1)^2} - \cancel{\frac{e^{-Ts-2}}{(e^{-Ts-2}-1)^3}} \right)$$

$\therefore \text{Für } z, N(z) \neq X(s) \cup \{0\}$

$$X(z) = X(s) \Big|_{s=\frac{1}{T} \ln z} \quad e^{-Ts} = e^{-\frac{1}{T} \ln z} = e^{-\ln z} = e^{\ln z^{-1}} = z^{-1}$$

$$N(z) = \frac{2}{27} \left(\frac{1}{e^{-8z^{-1}}-1} - \frac{1}{e^{-2z^{-1}}-1} \right) - \frac{I}{27} \left(\frac{e^{2Tz^{-1}}}{(e^{-2z^{-1}}-1)^2} + \frac{16e^{-8Tz^{-1}}}{(e^{-8z^{-1}}-1)^2} \right)$$

$$= \frac{64I^2}{9} \left(\frac{e^{-16z^{-1}}}{(z^{-1}e^{-1})^2} - \frac{2e^{-2Tz^{-1}}}{(e^{-8z^{-1}}-1)^3} \right) \quad \checkmark$$

1) \therefore

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$$X(s) = \frac{4}{s(s+1)^2(s+3)} \left\{ \begin{array}{l} P_1 = 0 \\ P_2 = 1 \\ P_3 = -3 \end{array} \right\} \text{ Ans}$$

$$X^*(s) = \lim_{P \rightarrow 0} \left[\frac{\frac{4}{(P+1)^2(P+3)}}{1-e^{-T(s-P)}} \right] + \lim_{P \rightarrow -1} \frac{1}{e^P} \left(\frac{4}{(P+3)} P \frac{1}{1-e^{-T(s-P)}} \right)$$

$$\rightarrow \lim_{P \rightarrow -3} \left[\frac{\frac{4}{(P+1)^2 P}}{1-e^{-T(s-P)}} \right]$$

$$= \frac{4}{3} \frac{1}{1-e^{-Ts}} - \frac{1}{3} \frac{1}{1-e^{-T(s+1)}} - \frac{1}{3} \frac{1}{1-e^{-T(s+3)}} - \frac{2Te^{-T(s+1)}}{(1-e^{-T(s+1)})^2}$$

$$x(z) = \frac{4}{3} \frac{1}{1-z^{-1}} - \frac{1}{3} \frac{1}{1-e^{-T} z^{-1}} - \frac{1}{3} \frac{1}{1-e^{-3T} z^{-1}} - \frac{2Te^{-Tz^{-1}}}{(1-e^{-Tz^{-1}})^2} \quad \checkmark$$

$$P^2 + 3P - P e^{-T(s-P)} - 3P e^{-T(s-P)}$$

$$- (2P + 3 - 2Pe^{-T(s-P)} + Te^{-T} P^2 - 3e^{-T(s-P)}) + T 3P e^{-T(s-P)}$$

2)

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$$X(s) = \frac{1 - e^{-Ts}}{s(s+2)(s+5)}$$

$$\rightarrow x(t) = X(z) z Z(\chi(s)) z (1-z^{-1}) \left[Z\left(\frac{1}{s(s+2)(s+5)}\right)\right]$$

$$\frac{1}{s(s+2)(s+5)} = \frac{1}{10} \left(\frac{1}{s}\right) + \frac{-1}{6} \left(\frac{1}{s+2}\right) + \frac{1}{15} \left(\frac{1}{s+5}\right)$$

$$Z\left(\frac{1}{s}\right) = \frac{1}{10} \frac{1}{1-z^{-1}} - \frac{1}{6} \frac{1}{1-e^{-2T}z^{-1}} + \frac{1}{15} \frac{1}{1-e^{-5T}z^{-1}}$$

$$X(z) z (1-z^{-1}) Z\left(\frac{1}{s}\right)$$

$$= \frac{1}{10} - \frac{1}{6} \frac{1-z^{-1}}{1-e^{-2T}z^{-1}} + \frac{1}{15} \frac{1}{1-e^{-5T}z^{-1}}$$

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$$X^a(s) ?$$

$$x(t) = \sin(\omega t) \quad \text{L} \rightarrow \frac{1}{s^2 + 1} = \frac{1}{(s-j)(s+j)}$$

$$\Rightarrow \frac{a}{s^2 + a^2} = \frac{a}{(s-a\jmath)(s+a\jmath)} = \frac{1}{s-a\jmath} \left(\frac{a}{2a\jmath} \right) + \frac{1}{s+a\jmath} \left(\frac{-a}{2a\jmath} \right) = \frac{1}{s-j} \left(\frac{1}{2\jmath} \right) + \frac{1}{s+j} \left(\frac{1}{2\jmath} \right)$$

$$X^a(s) \in \left\{ \text{Res} \right\} X(p_i) \frac{1}{1 - e^{-T(s-p_i)}} \quad \text{L}$$

$$= \frac{a}{2\jmath} \frac{1}{1 - e^{a\jmath} e^{-Ts}} + \frac{-a}{2\jmath} \frac{1}{1 - e^{-a\jmath} e^{-Ts}}$$

$$= \frac{1}{2\jmath} \frac{1}{1 - e^{-a\jmath} e^{-Ts}} + \frac{+a}{2\jmath} \frac{1}{1 - e^{-a\jmath} e^{-Ts}}$$

$$\therefore 1 - e^{-at} \stackrel{\text{L}}{\sim} \frac{1}{s} - \frac{1}{s+a} e$$

$$X^a(s) = \frac{1}{1 - e^{-aT} e^{-Ts}} + \frac{-1}{1 - e^{-aT} e^{-Ts}} \times (z) \stackrel{z=1}{=} \frac{1}{1-z} + \frac{-1}{1-e^{-aT}}$$

$$\therefore \frac{e^{-bTz}}{s-2} \Rightarrow (-bZ^{-1}) Z \left(\frac{1}{s-2} \right)$$

$$e^{-sTb} \quad \frac{1}{1 - e^{-sT(b-T(s-2))}}$$

(4)

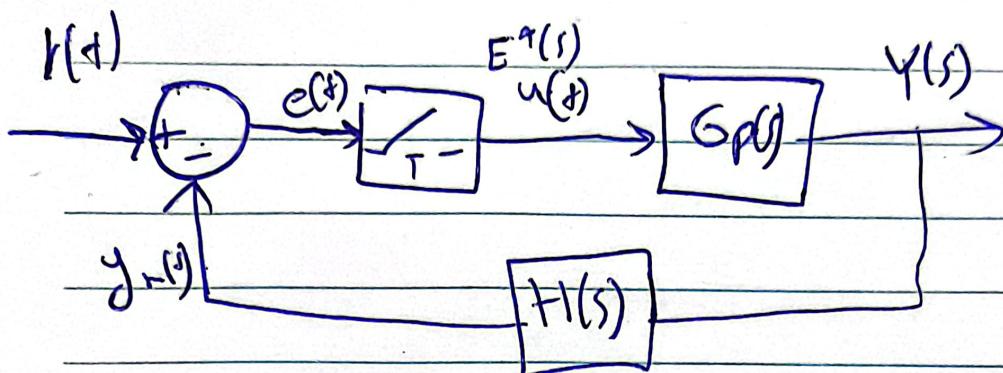
$$\frac{e^{-bTz}}{1 - e^{-sT(b-T(s-2))}}$$

(4)

4) Subject: W1

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$$H(s)G(s) \approx H(s)$$



$$\left\{ \begin{array}{l} Y(s) = G_p(s) E^*(s) \\ E(s) = R(s) - G_p(s) H(s) E^*(s) \end{array} \right. \Rightarrow Y^*(s) = G_p^*(s) E^*(s)$$

$$E^*(s) = \frac{R(s)}{1 + G_p H^*(s)}$$

$$Y^*(s) = \frac{R^*(s) G_p^*(s)}{1 + G_p H^*(s)}$$

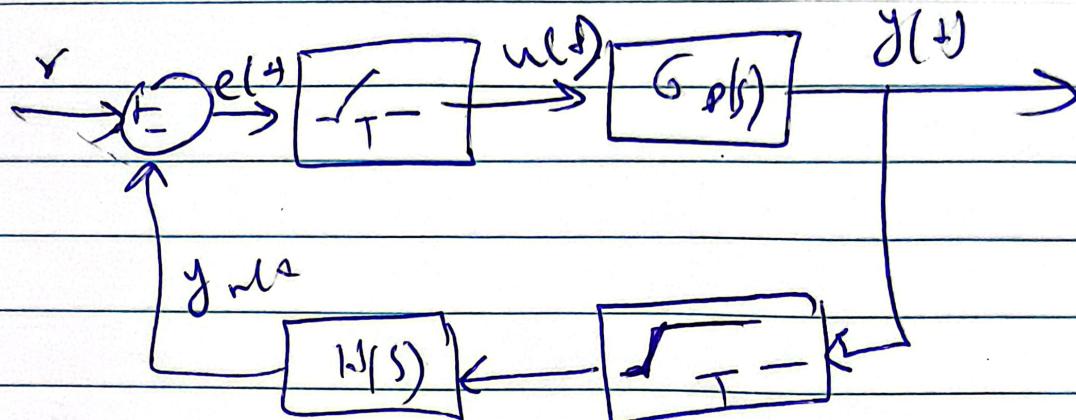
$$Y(z) = \frac{R(z) G_p(z)}{1 + G_p H(z)}$$

$$T(z) = \frac{Y(z)}{R} = \frac{G_p(z)}{1 + G_p H(z)}$$

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$$y(s) = E^*(s) G_p(s)$$

$$E^*(s) = R(s) - Y'(s) H(s)$$

$$Y'(s) = E^*(s) G_p(s)$$

$$E^*(s) = R(s) - Y'(s) H(s)$$

$$\frac{Y'(s)}{R(s)} = \frac{G_p(s)}{1 + H(s) G_p(s)}$$

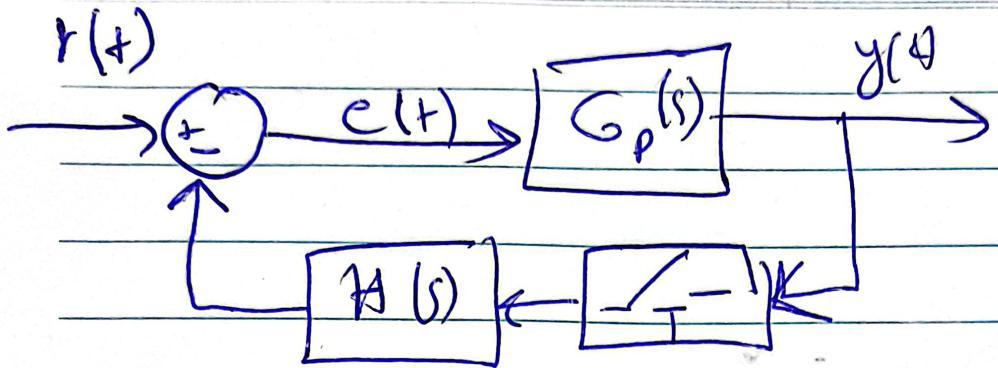
$$\frac{Y(z)}{R(z)} = \frac{G_p(z)}{1 + H(z) G_p(z)}$$

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4) ج

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$$\left\{ \begin{array}{l} Y(s) = G_p(s) E(s) \\ E(s) = R(s) - H(s) Y(s) \end{array} \right. \quad \left\{ \begin{array}{l} Y(s) = G_p(s) E^*(s) \\ E^*(s) = R^*(s) - H^*(s) Y^*(s) \end{array} \right. \quad \begin{array}{l} ① \\ ② \end{array}$$

ل) ۱) ۲) میتوانیم از این دو معادله برای حذف E^* استفاده کرد

۱) $\text{حاکمیت کنترل مبارزه نمودار را در نظر بگیرید}$

۲) $\text{متوجه تبدیل یا تغییر متغیر را در نظر بگیرید}$

$$Y(2) = \frac{R G_p(2)}{1 + H G_p(2)} X$$

نمودار را در نظر بگیرید

5)

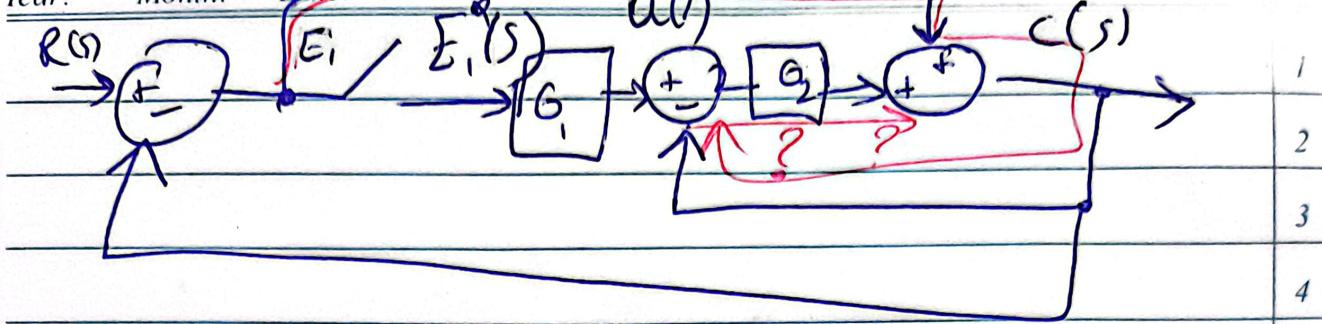
حُسْنِی، نہیں ملے تا ج گالی را حاصل کر لے

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$$C(s) = E_i(s) + \underbrace{\left(E_i(s)G_1(s) - C(s) \right)}_{U(s)} G_2(s) \quad ①$$

~~G(s)~~

~~$V(s) = G_1(s) E_i(s) \quad ②$~~

$$E_i(s) = R(s) - C(s) \quad ③$$

(③ ②، ①) مطابق، تسلیم

تمکل (Feed forward) عمل نیوہ برداری بازبندی

بعض تبدیل اسیں کر دے تا سینہ میں تبدیل ہوں گے، رائج نام دار

1) آگرہ میں دیسے اور را دریافت کشم کشم دیکھ دیں تو اسیں آرڈر اچیلہ کیسٹر

③

6)

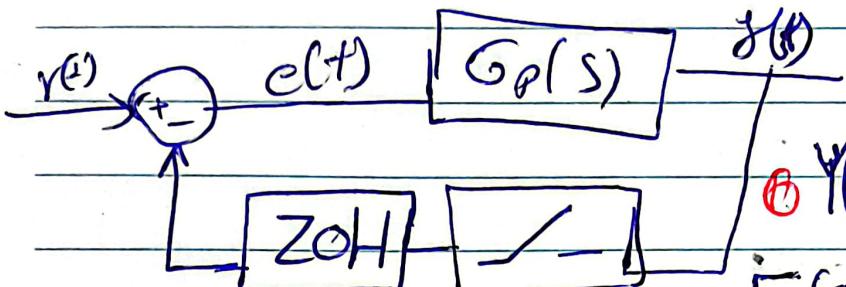
6.1

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$$G_p(s) = \frac{K_1}{s+1} \quad (3)$$

$$ZOH: \frac{1-e^{-Ts}}{s} d(t)$$



$$(1) Y(s) = E(s) G_p(s)$$

$$\dot{E}(s) = R(s) - Y(s) I(s)$$

$$(2) E(s) = R(s) - Y(s) \frac{1-e^{-Ts}}{s}$$

$$(1) (2) \Rightarrow Y(s) = G_p(s) [R(s) - Y^*(s) \frac{1-e^{-Ts}}{s}]$$

$$Y^*(s) = \left(G_p(s) R(s) \right)^* - Y^*(s) \left(G_p(s) \frac{1-e^{-Ts}}{s} \right)^*$$

$$Y^*(s) = \frac{G_p(G_p R(s))^*}{1 + (G_p \frac{1-e^{-Ts}}{s})^*} \Rightarrow Y(z) = \frac{G_p R(z)}{1 + G_p H(z)}$$

$$G_p R(s) = \frac{2}{s(s+1)} \quad \cancel{\text{cancel}} = \frac{2}{s} + \frac{-2}{s+1}$$

$$(G_p R(s))^* = \frac{2}{1-e^{-Ts}} - \frac{2}{1-e^{-Ts} e^{-T}} \Rightarrow \frac{2}{1-z^{-1}} - \frac{2}{1-e^{-T} z^{-1}}$$

$$G_p H = \frac{2(1-e^{-T})}{s(s+1)} \Rightarrow (1-z^1) \left(\frac{2}{1-z^{-1}} - \frac{2}{1-e^{-T} z^{-1}} \right)$$

$$= 2 - \frac{2(1-z^1)}{1-e^{-2T} z^{-1}}$$

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6.2

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$$y(z)_2 = \frac{\left(\frac{2}{1-z^{-1}} - \frac{2}{1-e^{-T}z^{-1}} \right)}{1 + (1-z^{-1}) \left(\frac{2}{1-z^{-1}} - \frac{2}{1-e^{-T}z^{-1}} \right)}$$

$$= \frac{-2z^{-1}(e^{-T}-1)}{(1-z^{-1})(1-e^{-T}z^{-1}) + (1-z^{-1})(-2z^{-1})(e^{-T}-1)}$$

$$= \frac{-2z^{-1}(e^{-T}-1)}{(1-z^{-1})(1-e^{-T}z^{-1}) + (1-z^{-1})(-2z^{-1})(e^{-T}-1)}$$

$$= \frac{A_1}{1-z^{-1}} + \frac{A_2}{(1+z^{-1})(-3e^{-T}+2)}$$

$$= \frac{A_1}{1-z^{-1}} + \frac{A_2}{(1+z^{-1})(-3e^{-T}+2)}$$

$$\boxed{-\frac{2}{3}}$$

$$y[n]_2 = \boxed{\frac{2}{3}} u[n] + \left(\frac{-2}{3} \right) (+3e^{-T}-2) u[n]$$

$$n=0 \Rightarrow \frac{2}{3} - \frac{2}{3} e^0$$

$$n=1 \Rightarrow \frac{2}{3} - \frac{2}{3} (+3e^{-0.2}-2)$$

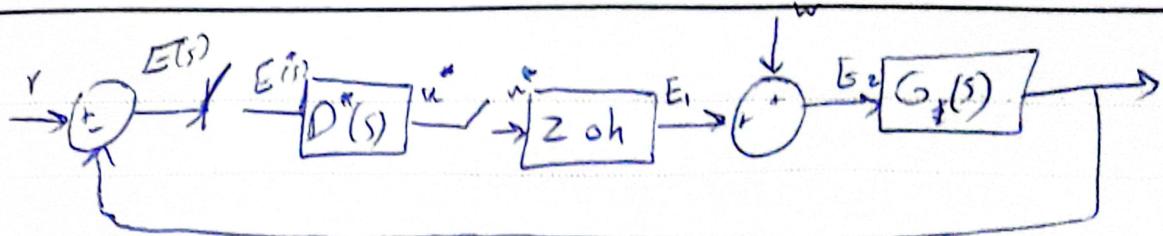
$$n=2 \Rightarrow \frac{2}{3} - \frac{2}{3} (+3e^{-0.2}-2)^2$$

$$n=3 \Rightarrow \frac{2}{3} - \frac{2}{3} (+3e^{-0.2}-2)^3$$

$$\lim_{n \rightarrow \infty} y[n]_2 = \lim_{z \rightarrow 1^-} (1-z^{-1}) y(z) = \boxed{\frac{2}{3}}$$

$$y[n]_2 \underset{n \rightarrow \infty}{\rightarrow}$$

1s



$$E_2 = E_1 + w$$

$$E_1 = Zoh \quad U^* = \frac{1 - e^{-Ts}}{s} V^*(s)$$

$$Y(s) = G(s) E_2(s)$$

$$E(s) = R(s) - Y(s) = -G(s) E_2(s) \Rightarrow E(s) = -G E(s) \Rightarrow \boxed{-G E(s)}$$

$$V(s) \in D'(s) E^*(s) \Rightarrow V^* = D'(s) E^*(s) = -D'(s) Y(s)$$

$$E_2^* = E_1^* + w^*$$

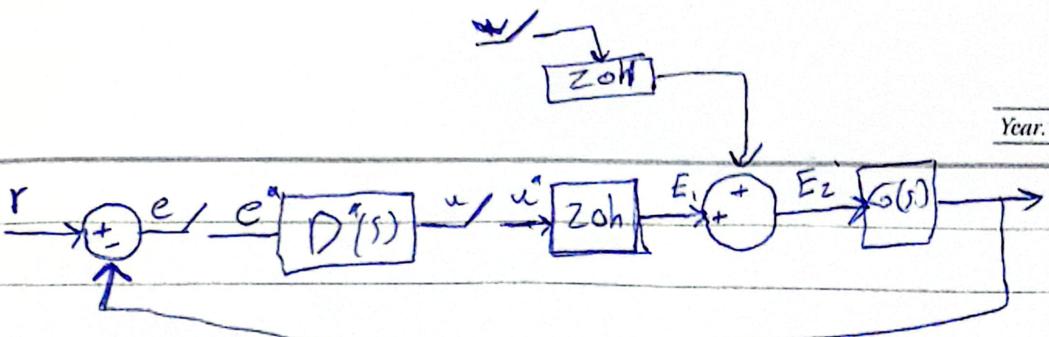
$$\Rightarrow E_2^*(s) = \left[\frac{1 - e^{-Ts}}{s} \right] D'(s) (-E_2 G(s)) + w^*(s)$$

$$\Rightarrow E_2(z) = (1-z) \left\{ \frac{D(z) E_2 G(z)}{s} + \frac{w(z)}{s} \right\}$$

$$y \Rightarrow G E^*(s) = G w^*(s)$$

$$E_1^*(s) = \left[\frac{1 - e^{-Ts}}{s} \right] D'(s) (G E^*(s) + G w^*(s))$$

$$E_1(z) = (1-z) \times (-1) \times \left(z \left\{ \frac{G w^*(s)}{s} \right\} + \frac{E_1 G(z)}{s} \right) D(z)$$



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$$E_2 = E_1 \cdot w^*(s) \left(1 - e^{-Ts}\right)$$

$$\psi(t) = E_2 G(s)$$

$$e_2 = r + \psi \Rightarrow e^* = -\psi(s)$$

$$E_1 = U^* \left(\frac{1 - e^{-Ts}}{s} \right)$$

$$U(s) = E^*(s) D^*(s) \Rightarrow U^*(s) = E^* D^*(s) = -E_2 G(s) D^*(s)$$

~~$$E_2 = (E_1(s)) \cdot \frac{1 - e^{-Ts}}{s} (U(s) w^*(s))$$~~

$$E_1(s) = \frac{1 - e^{-Ts}}{s} (-E_2 G(s) D^*(s) + w^*(s))$$

$$E_2(z) = -(1-z) \left(z \left(\frac{E_1 G(s) D^*(s)}{s} \right) + z \left(\frac{w^*(s)}{s} \right) \right)$$

$$E_1^*(s) = \left[\frac{1 - e^{-Ts}}{s} \right] D^*(s) \left(-G E^*(s) - \left[G(s) \frac{1 - e^{-Ts}}{s} \right] w^*(s) \right)$$

$$E_1(z) = -(1-z) \left(z \left\{ \frac{D(s)}{s} G E_1^*(s) \right\} + (1-z) z \left\{ \frac{G(s) \cancel{w^*(s)}}{s^2} \right\} G(w(z)) \right)$$

$$z^{n-3} \rightarrow [3]$$

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8) a) $z^3 + 0.8z^2 + 0.05z - 0.2 = 0$

$$\begin{array}{cccc|c} & 1 & 0.8 & 0.05 & -0.2 \\ & \downarrow & \downarrow & \downarrow & \downarrow \\ a_3 & a_2 & a_1 & a_0 \end{array}$$

① ~~a_3~~ -0.2 0.05 0.8 |

② 1 0.8 0.05 -0.2

③ -0.96 ~~2.01~~ ~~-1.41~~ 0

i) $|a_3| < 1$ $|a_1| \Rightarrow |0.2| < 1 \checkmark$

ii) $|\Delta(z)|_{z=1} \geq 0 \geq 3.65 \checkmark$

~~$b_{n-1} < 0.2$~~ ~~a_{n-15}~~ ~~a_0~~ $\text{③ } |\Delta(z)|_{z=1} < -0.45 \checkmark$

④ $|b_{n-1}| < |b_0|$

~~$0.26 < 0.96$~~

~~-1.41~~

~~1.41~~

~~1.41~~

$$8) \quad \textcircled{5}) \quad 2n-3 = \textcircled{7}$$

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$$b_{k-2} \begin{vmatrix} a_0 & a_{n-k} \\ a_n & a_k \end{vmatrix}$$

$$\begin{aligned} z^5 + 2.6z^4 - 0.56z^3 - 42.65z^2 + 0.0775z \\ + 0.35 \end{aligned}$$

$\textcircled{1}$	0.35	0.0775	-2.05	-0.56	2.6	1
$\textcircled{2}$	1	2.6	-0.56	-2.65	0.0775	0.35
$\textcircled{3}$	-0.8775	-2.572	-0.1575	1.854	0.835	0
$\textcircled{4}$	0.8325	1.854	-0.1575	-2.572	-0.8775	0
$\textcircled{5}$	0.07695	0.71424	0.2693	0.515	0	9
$\textcircled{6}$	0.515	0.2693	0.714	0.07695	0	10
$\textcircled{7}$	-0.25934	-0.08375	-0.34714			11
						12
						13
						14
						15

$$1) a_0 \cancel{\neq} a_n \Rightarrow 0.35 \quad 1 \quad \checkmark$$

b) ✓

$$2) D(z) \Big|_{z=+1} > 0 \quad 1.4175 \quad \checkmark$$

$$3) D(z) \Big|_{z=-1} < 0 \quad 0.3825 \quad \times$$

$$4) |b_1| < |b_0| \quad |0.8325| < |-0.8775| \quad \checkmark$$

$$5) |c_{n-2}| < |c_0| \quad |0.515| < |0.076| \quad \times$$

X

| b |

9)

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Q

$$\text{w1) } z^3 - 1.2z^2 - 1.375z - 0.25z \rightarrow \left\{ \begin{array}{l} 1.96 \\ -0.51 \\ -0.24 \end{array} \right.$$

$$z = \frac{1+w}{1-w}$$

مجهولی $(1-w)^3$ را بدل کنید، سه کل

$$w^3 + 3w^2 + 3w + 1 - 1.2 - 1.2w + 1.2w^2 + 1.2w^3$$

$$-1.375 + 1.375w + 1.375w^2 - 1.375w^3$$

$$-0.25 + 0.75w - 0.75w^2 + 0.75w^3 =$$

$$= -1.875w^3 + 3.925w^2 + 4.825w + 1.075$$

$$w^3 - 1.875$$

$$3.925$$

$$w^2 4.825$$

$$1.075$$

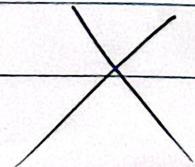
$$w^1 - 4.342$$

$$0$$

$$w^0$$

(مجهولی را بازبینی کریم، یک تجزیه

طبقی می‌دانم و این دهمین بارم P



9) \rightarrow

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$$2Z^4 + 7Z^3 + 10Z^2 + 4Z + 1 = 0$$

$$2w^4 + 8w^3 + 12w^2 + 8w + 2$$

$$-7w^4 - 14w^3 - 14w - 7$$

$$10w^4 - 20w^2 + 10$$

$$-4w^4 + 8w^3 - 8w + 4$$

$$w^4 - 4w^3 + 6w^2 - 4w + 1$$

$$= w^4 + 0.416w^3 - 0.083w^2 - 0.083w + 0.083$$

~~$w^4 + 0.416w^3 - 0.083w^2 - 0.083w + 0.083$~~

$$w^4 - 0.416 + 0.083$$

$$w^3 + 0.416 - 0.083 = 0$$

$$w^2 - 0.416 + 0.083 = 0$$

$$w^1 - 0.214$$

$$w^0$$

X

a \checkmark $\{ \text{b}, \text{c} \}$ fails \checkmark $\{ \text{d}, \text{e} \}$?