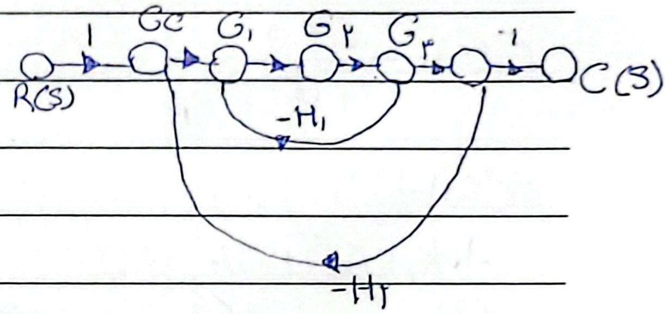
Subject Year: Month: Day:

- به نام خدا
- نازنین عطریان
- تمرین سری اول

① $\frac{C(S)}{R(S)} = ?$ $\frac{C(S)}{D(S)} = ?$



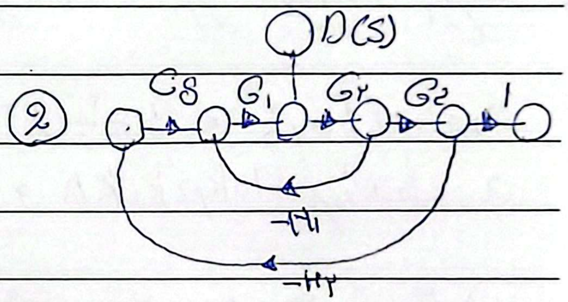
$P_1 = G_c G_1 G_2 G_e$ $l_{1-1} = -G_c G_1 G_2 G_e H_2$

$\Delta_1 = 1$ $l_{1-2} = -G_1 G_2 H_1$

$$\frac{C(S)}{R(S)} = \frac{G_S G_1 G_2 G_e}{1 + G_1 G_2 H_1 + G_c G_1 G_2 G_e H_2}$$

② $P_1 = G_2 G_3$ $l_{1-1} = -G_c G_1 G_2 G_e H_2$

$\Delta_1 = 1$ $l_{1-2} = -G_1 G_2 H_1$



$$\frac{C(S)}{D(S)} = \frac{G_2 G_e}{G_c G_1 G_2 G_e H_2 + G_1 G_2 H_1 + 1}$$

2- $\dot{X} = AX + BU$ $Y = CX + DU$

$$\underbrace{\begin{bmatrix} \dot{u} \\ \dot{w} \\ \dot{q} \\ \dot{\theta} \end{bmatrix}}_{\dot{x}} = \underbrace{\begin{bmatrix} -0/5 & 0/1 & 0/2 & 0 \\ 0/3 & -0/4 & 0/1 & 0 \\ 0/2 & 0/1 & -0/6 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} u \\ w \\ q \\ \theta \end{bmatrix}}_{x} + \underbrace{\begin{bmatrix} 0/1 \\ 0/2 \\ 0/3 \\ 0 \end{bmatrix}}_{B} \underbrace{\delta}_{u}$$

$$Y = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} u \\ w \\ q \\ \theta \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} \delta$$

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(3) $G'(s)=G_1(s)G_2(s)G_c(s)$ $\qquad G_1(s)=\frac{k_1}{s}\,,\; G_2(s)=\frac{10}{s+10}$

$$G_c(s)=\frac{-k_A(1+sT_A)}{(s^2+2\zeta_p\omega_{sp}s+\omega_{sp}^2)}$$

$$G'(s)=\left(\frac{k_1}{s}\right)\left(\frac{10}{s+10}\right)\left(\frac{-k_A(1+sT_A)}{(s^2+2\zeta_p\omega_{sp}s+\omega_{sp}^2)}\right)$$

$$G(s)=\frac{G'(s)}{1+G'(s)k_q}$$

$$s(s+10)(s^2+2\zeta\omega_{ps}+\omega_{sp}^2)q(s)+10k_q k_1 k_A(1+sT_A)q(s)$$
$$=-10k_1k_A(1+sT_A)q'(s)$$

$$\frac{d^3q}{dt^3}+a_2\frac{d^2q}{dt^2}+a_1\frac{dq}{dt}+a_0q=b_1\frac{dq'}{dt}+b_0q'$$

$a_2=10+2\zeta\omega_{ps}$, $a_1=10(2\zeta\omega_{ps})+\omega_{ps}^2+10k_qk_1k_AT_A$

$a_0=10\omega_{sp}^2+10k_qk_1k_A$, $b_0=-10k_1k_A$, $b_1=-10k_1k_AT_A$

(4) $\dddot{y}-\ddot{y}+3\dot{y}+4y=2\dddot{u}+6\ddot{u}-\dot{u}+3u$

$\dddot{y}+a_1\ddot{y}+a_2\dot{y}+a_3y=b_0\dddot{u}+b_1\ddot{u}+b_2\dot{u}+b_3u$

$b_0=2$

$a_1=-1 \qquad b_1=6$

$a_2=3 \qquad b_2=-1$

$a_3=4 \qquad b_3=3$

$$\left.\begin{array}{l} y_1=y\\ y_2=\dot{y}\\ y_3=\ddot{y}\end{array}\right\}\Rightarrow \left.\begin{array}{l}\dot{y}_1=\dot{y}\\ \dot{y}_2=\ddot{y}\\ \dot{y}_3=\dddot{y}\end{array}\right\}\Rightarrow \begin{array}{l}\dot{y}_1=y_2\\ \dot{y}_2=y_3\\ \dot{y}_3=-4y_1-3y_2+y_3+2\dddot{u}+6\ddot{u}-\dot{u}+3u\end{array}$$

$$\begin{bmatrix}\dot{y}_1\\ \dot{y}_2\\ \dot{y}_3\end{bmatrix}=\begin{bmatrix}0&1&0\\0&0&1\\-4&-3&1\end{bmatrix}\begin{bmatrix}y_1\\ y_2\\ y_3\end{bmatrix}+\begin{bmatrix}0\\0\\2\end{bmatrix}\dddot{u}+\begin{bmatrix}0\\0\\6\end{bmatrix}\ddot{u}+\begin{bmatrix}0\\0\\3\end{bmatrix}u$$

$$Y=\begin{bmatrix}1&0&0\end{bmatrix}\begin{bmatrix}y_1\\ y_2\\ y_3\end{bmatrix}+\begin{bmatrix}0\end{bmatrix}u$$

Ariyan