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N(Control Assignment) 3

Q:- 2

(a)

$$G(s) = \frac{3s^3 + s}{s^5 + 4s^4 + s^3 + 3s^2 + 5s + 7}$$

Solve

s^5	1	1	5
s^4	4	3	7
s^3	0.25	3.25	0
s^2	-51.66	7	0
s	3.284	0	0
s^0	7	0	0

The system is unstable as there is a sign changing effect in the 1st column of RHT. As two time sign changes in the table so, there are 2 (two) poles in the ORHP.

(b)

$$G(s) = \frac{-1}{s^4 + 5s^3 + 2s^2 + 3s + 1}$$

Solve

s^4	1	2	1
s^3	5	3	0
s^2	1.4	1	0
s^1	-0.57	0	0
s^0	1	0	0

The system is unstable as there is a sign chang in the 1st column of RHT. As, two times sign change in the table so, there will be two (2) poles present in the ORHP.

Q no- 3

Solve

$$G(s) = \frac{s+1}{s^4 + s^3 + 2s^2 - 3}$$

Applying PDD controller,

$$C(s) = K_p + K_{D1} s + K_{D2} s^2$$

close loop gain $\Rightarrow$

$$\frac{(s+1)(K_p + K_{D1} s + K_{D2} s^2)}{s^4 + s^3 + 2s^2 - 3 + (s+1)(K_p + K_{D1} s + K_{D2} s^2)}$$

The Auxiliary eqn-

$$\Rightarrow s^4 + s^3 + 2s^2 - 3 + K_p s + K_{D1} s^2 + K_{D2} s^3 + K_p + K_{D1} s + K_{D2} s^2 = 0$$

$$\Rightarrow s^4 + s^3(1 + K_{D2}) + s^2(2 + K_{D1} + K_{D2}) + s(K_p + K_{D1}) + K_p - 3 = 0$$

Making the RHT

s^4	1	$2+K_{D1}+K_{D2}$	$K_p - 3$
s^3	$1+K_{D2}$	$K_p + K_{D1}$	0
s^2	A	$K_p - 3$	0
s	B	0	0
s^0	$K_p - 3$	0	0

$$A = \frac{(1+K_{D2})(2+K_{D1}+K_{D2}) - K_p - K_{D1}}{1+K_{D2}}$$

$$A = \frac{K_{D2}^2 + 3K_{D2} + K_{D1}K_{D2} + 2 - K_p}{1+K_{D2}}$$

$$B = \frac{A(K_p + K_{D1}) - (1+K_{D2})(K_p - 3)}{A}$$

necessary conditions to stablize the above mentioned system,

$K_p - 3 > 0$, $\boxed{K_p > 3}$

$\boxed{A > 0}$

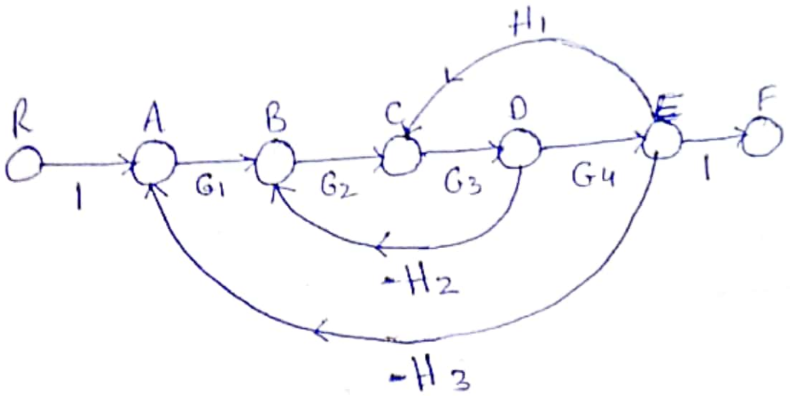
$\boxed{B > 0}$

- $K_p > 3$
- $K_{D1} > -1$
- $K_{D2} > -1$

Scanned with CamScanner

Q:-1

(a)



$DP_1 = G_1 G_2 G_3 G_4$

$L_1 = G_3 G_4 H_1$, $L_2 = -G_2 G_3 H_2$, $L_3 = -G_1 G_2 G_3 G_4 H_3$

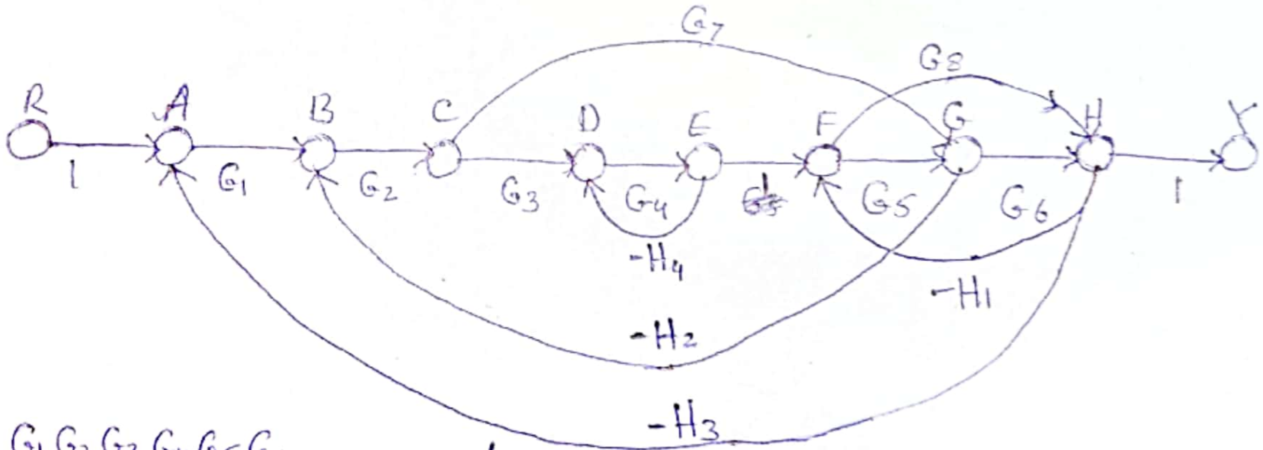
$\Delta = 1 - (L_1 + L_2 + L_3)$

As all loops are touching so

$\Delta_1 = 1$

$$\frac{Y}{R} = \frac{G_1 G_2 G_3 G_4}{1 - (L_1 + L_2 + L_3)} = \frac{F}{R}$$

(b)



$DP_1 = G_1 G_2 G_3 G_4 G_5 G_6$

$DP_2 = G_1 G_2 G_7 G_6$

$DP_3 = G_1 G_2 G_3 G_4 G_8$

$L_1 = -G_5 G_6 H_1$

$L_2 = -G_8 H_1$

$L_3 = -G_2 G_3 G_4 G_5 H_2$

$L_4 = -G_2 G_7 H_2$

$L_5 = -G_1 G_2 G_3 G_4 G_5 G_6 H_3$

$L_6 = -G_1 G_2 G_6 G_7 H_3$

$L_7 = -G_1 G_2 G_3 G_4 G_8 H_3$

$L_8 = -G_4 H_4$

$L_9 = -G_1 G_2 G_7 H_2$

Now

$$\Delta = 1 - (L_1 + L_2 + L_3 + L_4) + (L_1 L_4) + L_1 L_6 + L_1 L_9 + L_4 L_5 + L_4 L_6 + L_4 L_7 .$$

$$\Delta_1 = 1 - L_4$$

$$\Delta_2 = 1 = \Delta_3$$

$$\frac{Y}{R} = \frac{G_1 G_2 G_7 G_6 (1 - G_4 H_4) + G_1 G_2 G_3 G_4 G_8 + G_1 G_2 G_3 G_4 G_5 G_6}{1 - (L_1 + L_2 + L_3 + L_4 + L_5 + L_6 + L_7 + L_8 + L_9) + L_1 L_4 + L_1 L_6 + L_1 L_9 + L_4 L_5 + L_4 L_6 + L_4 L_7}$$