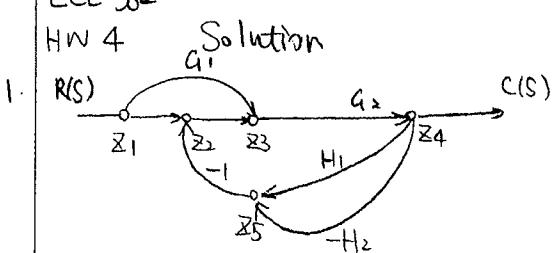


ECE 382

HW 4



There are 2 loops gains

$$L_1: z_2 z_3 z_4 z_5 z_2 \quad -G_2 H_1$$

$$L_2: z_2 z_3 z_4 z_5 z_2 \quad G_2 H_2$$

They are touching each other, So $\Delta = 1 - (L_1 + L_2) = 1 + G_2 H_1 - G_2 H_2$

List all the forward paths:

path	gains	cofactors
P1: $z_1 z_2 z_3 z_4$	$G_1 G_2$	1
P2: $z_1 z_3 z_4$	$G_1 G_2$	1

Remove P1 then there's no loops left

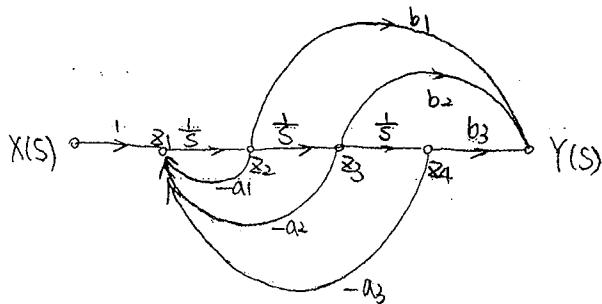
$$\therefore \Delta_1 = 1$$

Also remove P2 and no loops left

$$\therefore \Delta_2 = 1$$

$$\text{Therefore, } P = \frac{1}{\Delta} \sum P_k \Delta_k = \frac{G_1 + G_1 G_2}{1 + G_2 H_1 - G_2 H_2}$$

2. B-3-27



There are 3 loops gains

$$L_1: z_1 z_2 z_1 \quad -\frac{a_1}{s}$$

$$L_2: z_1 z_2 z_3 z_1 \quad -\frac{a_2}{s^2}$$

$$L_3: z_1 z_2 z_3 z_4 z_1 \quad -\frac{a_3}{s^3}$$

They are touching each other, So $\Delta = 1 - (L_1 + L_2 + L_3) = 1 + \frac{a_1}{s} + \frac{a_2}{s^2} + \frac{a_3}{s^3}$

Then we list all the forward paths:

paths	gains	cofactors
$P_1 : XZ_1 Z_2 Z_3 Z_4 Y$	$\frac{b_3}{S^3}$	1
$P_2 : XZ_1 Z_2 Y$	$\frac{b_1}{S}$	1
$P_3 : X Z_1 Z_2 Z_3 Y$	$\frac{b_2}{S^2}$	1

Removing P_1 and all branches that touch, it leaves an empty SFG
 So $\Delta_1 = 1$; same for $P_2 : \Delta_2 = 1$ and $P_3 : \Delta_3 = 1$.

$$\text{Therefore } P = \frac{1}{1 + \frac{a_1}{S} + \frac{a_2}{S^2} + \frac{a_3}{S^3}} \left(-\frac{b_3}{S^3} + \frac{b_1}{S} + \frac{b_2}{S^2} \right)$$

$$= \frac{b_1 S^2 + b_2 S + b_3}{S^3 + a_1 S^2 + a_2 S + a_3}$$