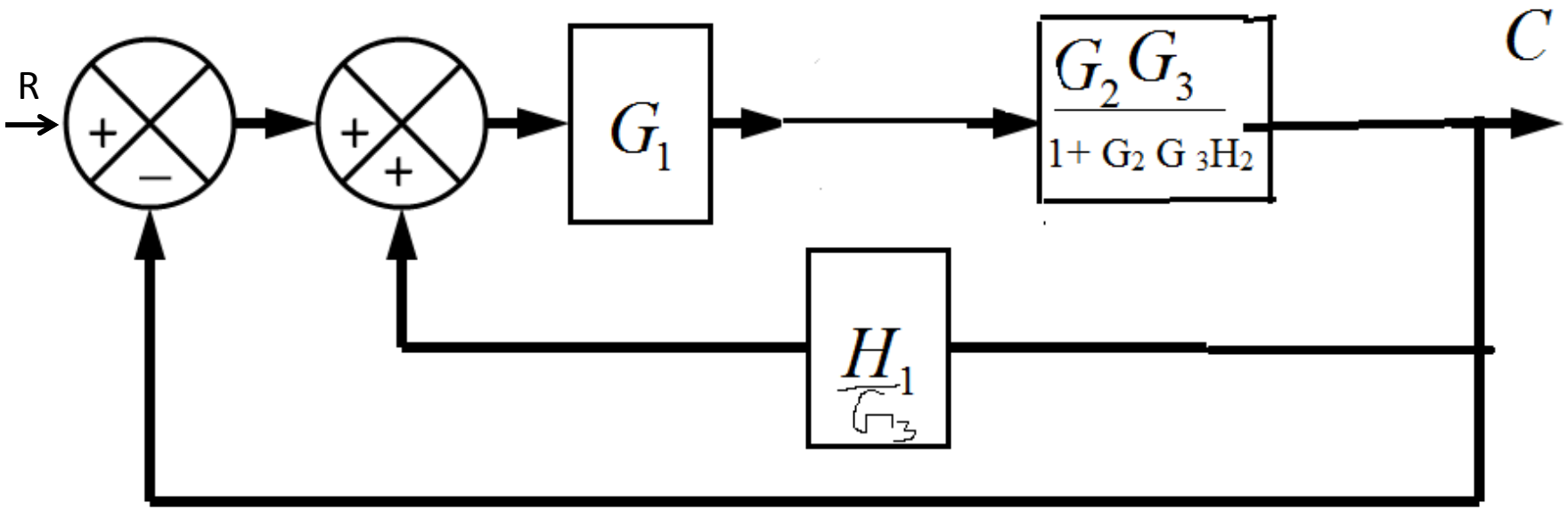
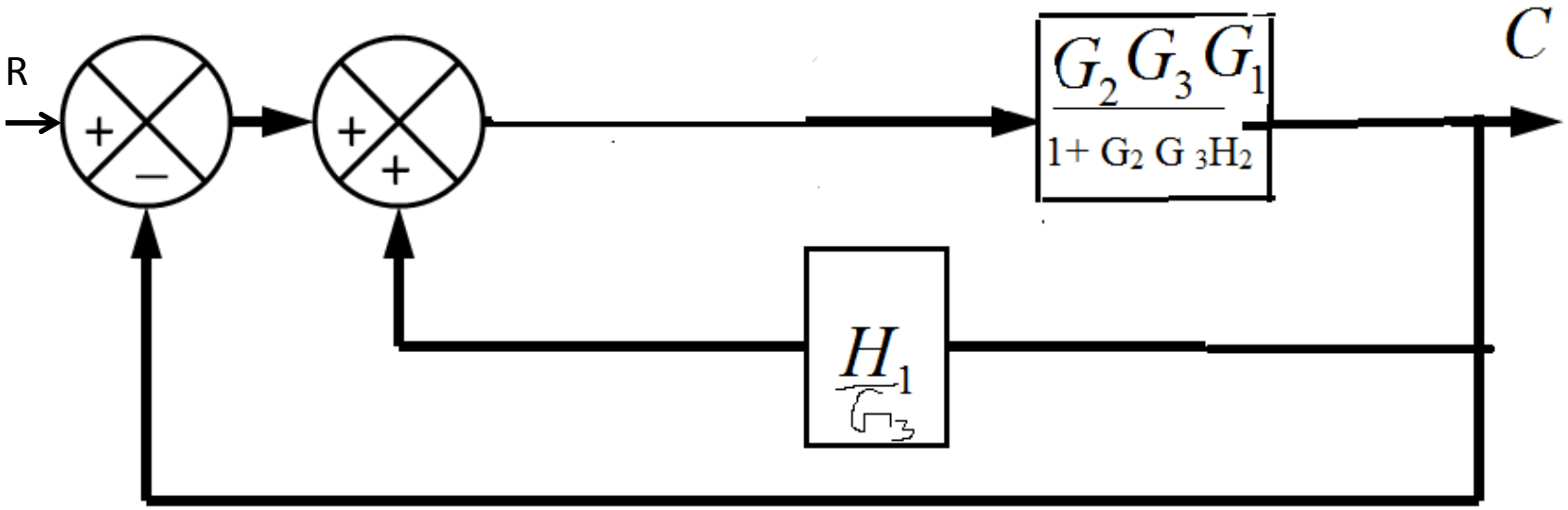
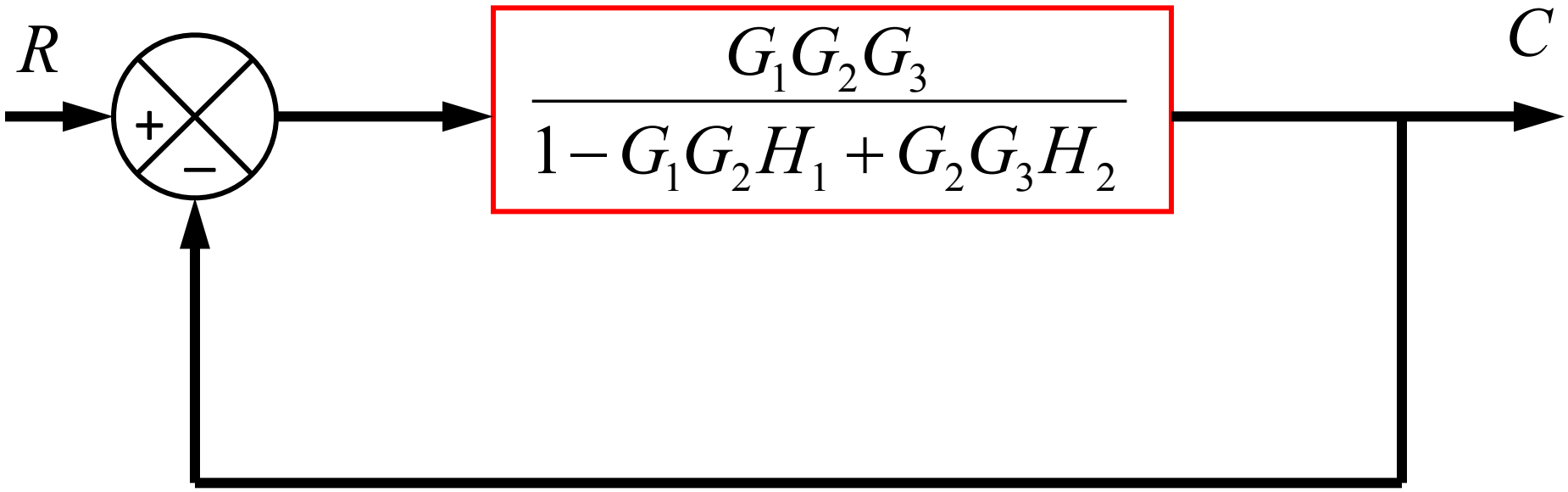
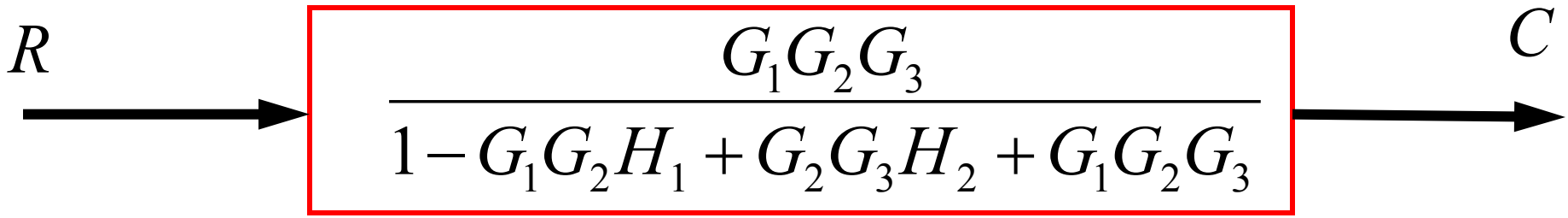
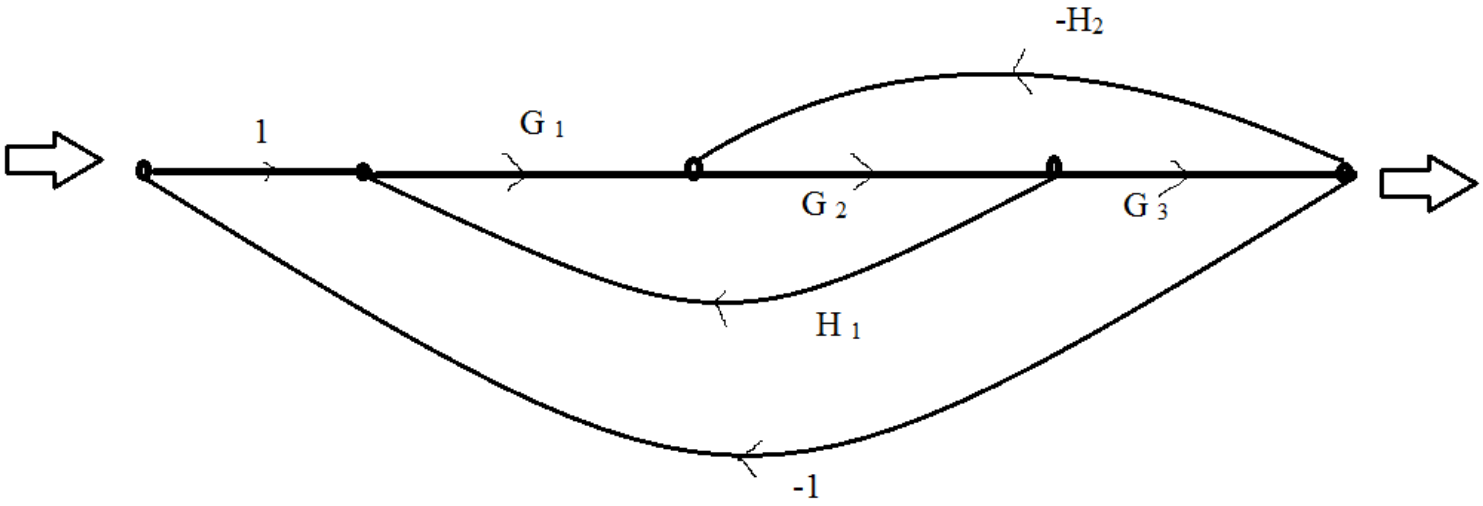

R
+
−
+
+
G_1
$\frac{G_2 G_3}{1+ G_2 G_3 H_2}$
C
H_1
G_3


R
+
−
+
+
$\frac{G_2 G_3 G_1}{1+ G_2 G_3 H_2}$
C
$\frac{H_1}{G_3}$

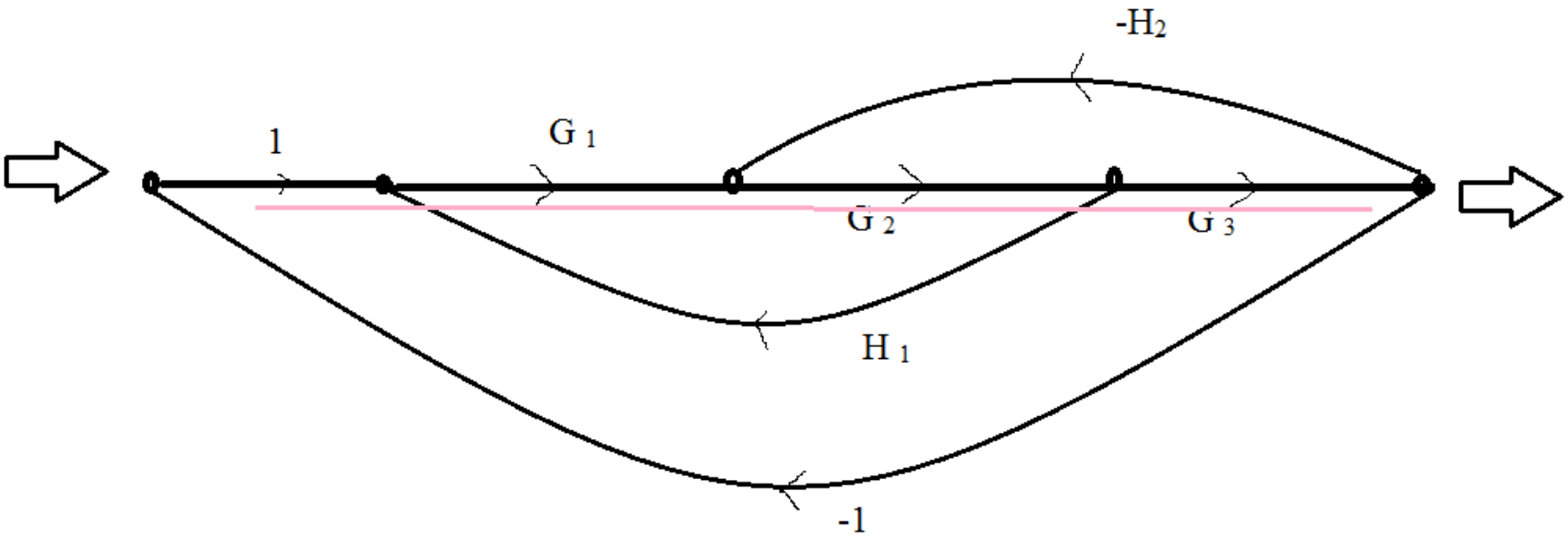

R
+
−
$\frac{G_1G_2G_3}{1-G_1G_2H_1+G_2G_3H_2}$
C


R
$\frac{G_1G_2G_3}{1-G_1G_2H_1+G_2G_3H_2+G_1G_2G_3}$
C

Solution for same problem by using SFG

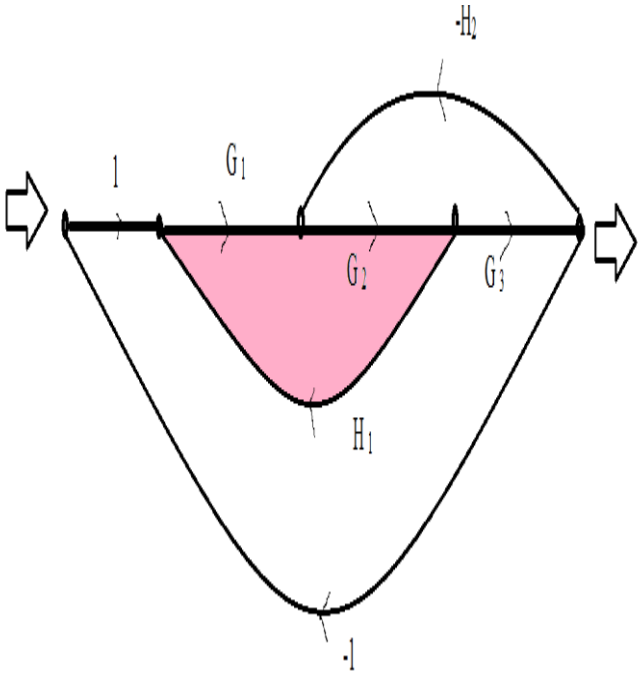


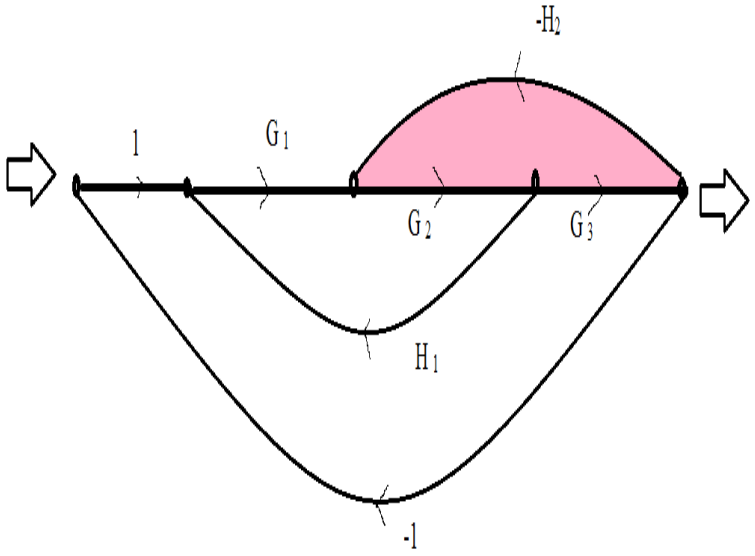
Forward Path



$P_1 = G_1 G_2 G_3$

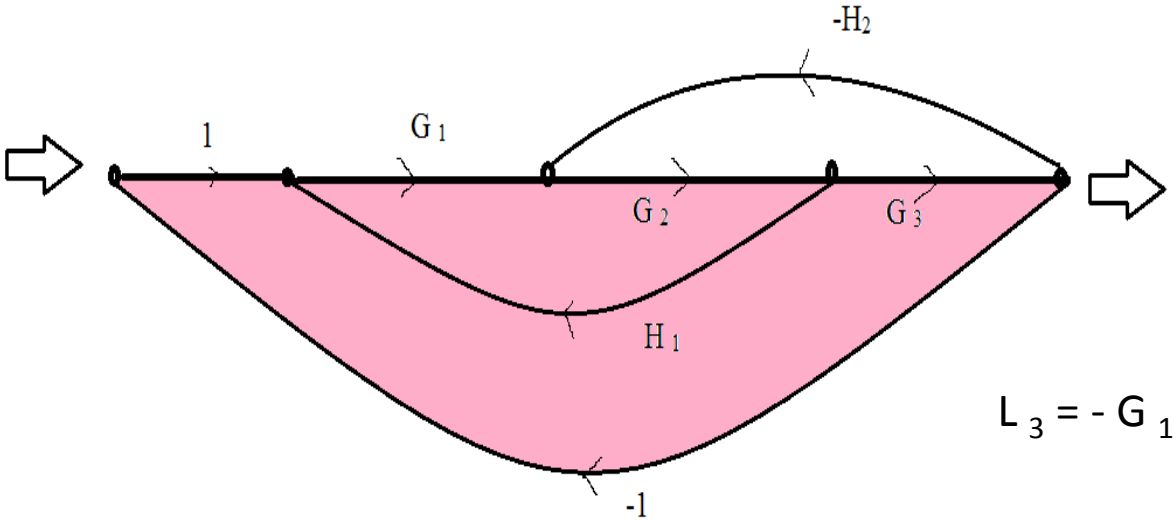
Loops





$L_1 = G_1 G_2 H_1$

$L_2 = - G_2 G_3 H_2$



$L_3 = - G_1 G_2 G_3$

$P_1 = G_1 G_2 G_3$

$L_1 = G_1 G_2 H_1$

$L_2 = - G_2 G_3 H_2$

$L_3 = - G_1 G_2 G_3$

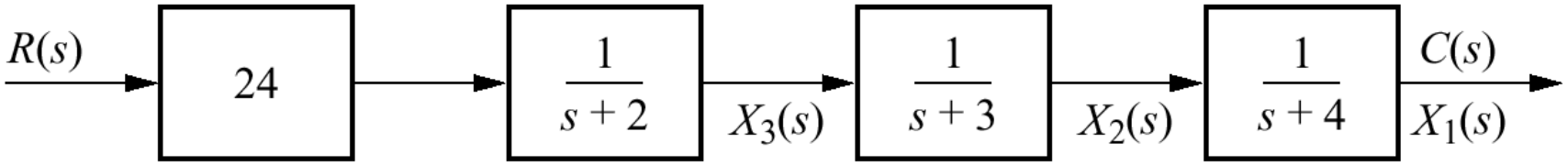
$\Delta_1 = 1$

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

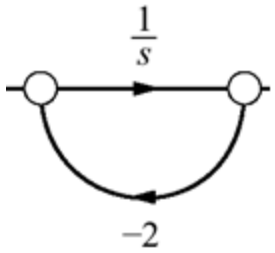
$T.F = (G_1 G_2 G_3) / [1 - G_1 G_2 H_1 + G_1 G_2 G_3 + G_2 G_3 H_2]$

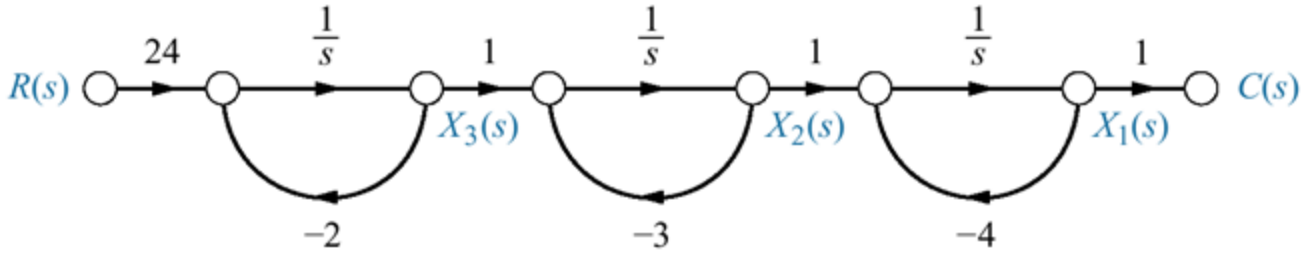
SFG from given T/F

$$\frac{C(s)}{R(s)} = \frac{24}{(s+2)(s+3)(s+4)}$$



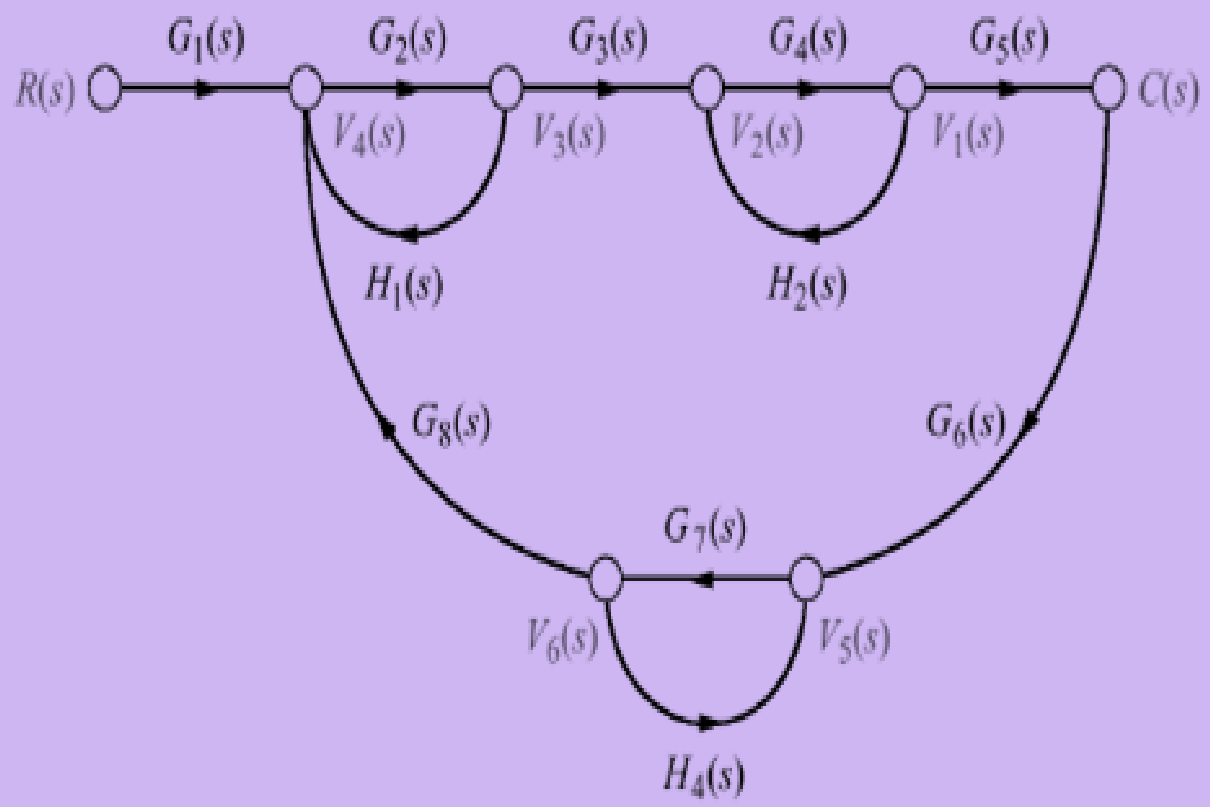
$$\frac{1}{(s+2)} = \frac{s^{-1}}{(1+2s^{-1})}$$



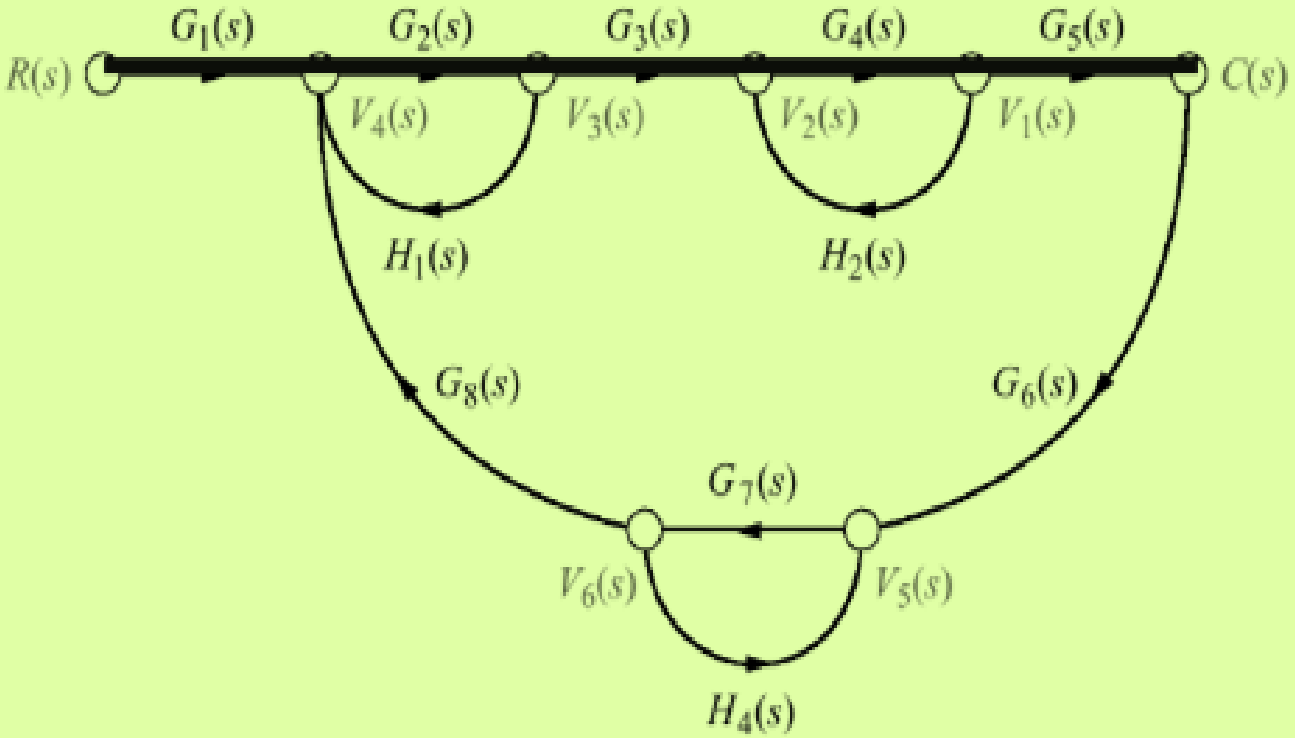


Ex:

Find the transfer function, C(s)/R(s), for the signal-flow graph in figure below

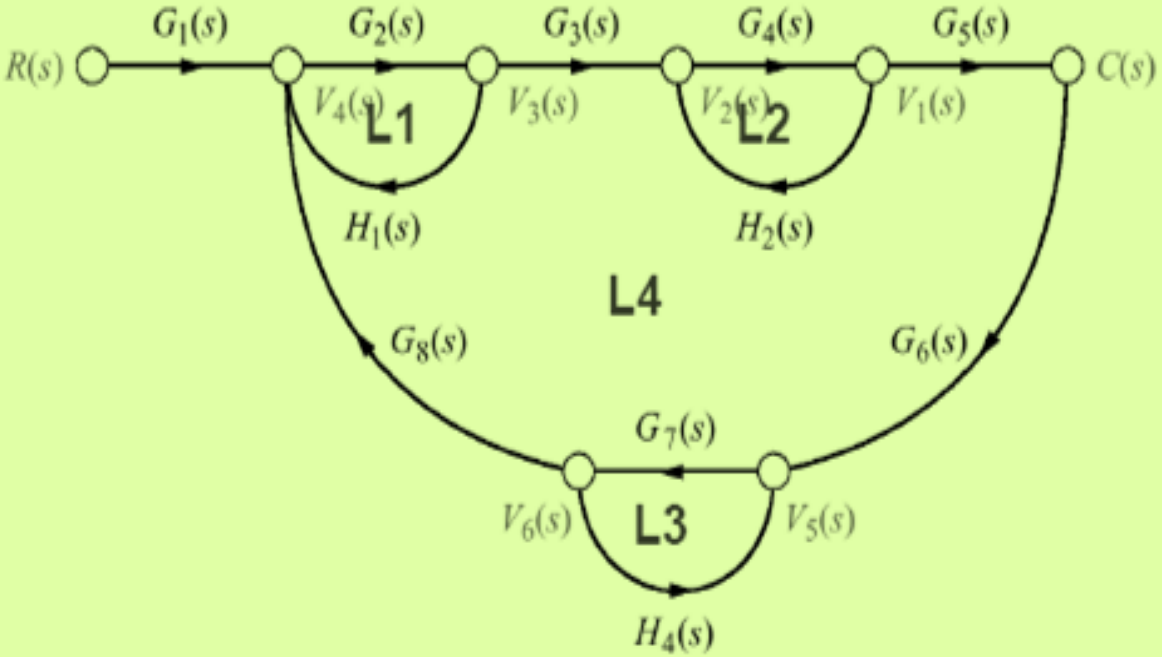


First, identify the **forward-path gains**.



F1. $G_1(s)G_2(s)G_3(s)G_4(s)G_5(s)$

Second, identify the **loop gains**.



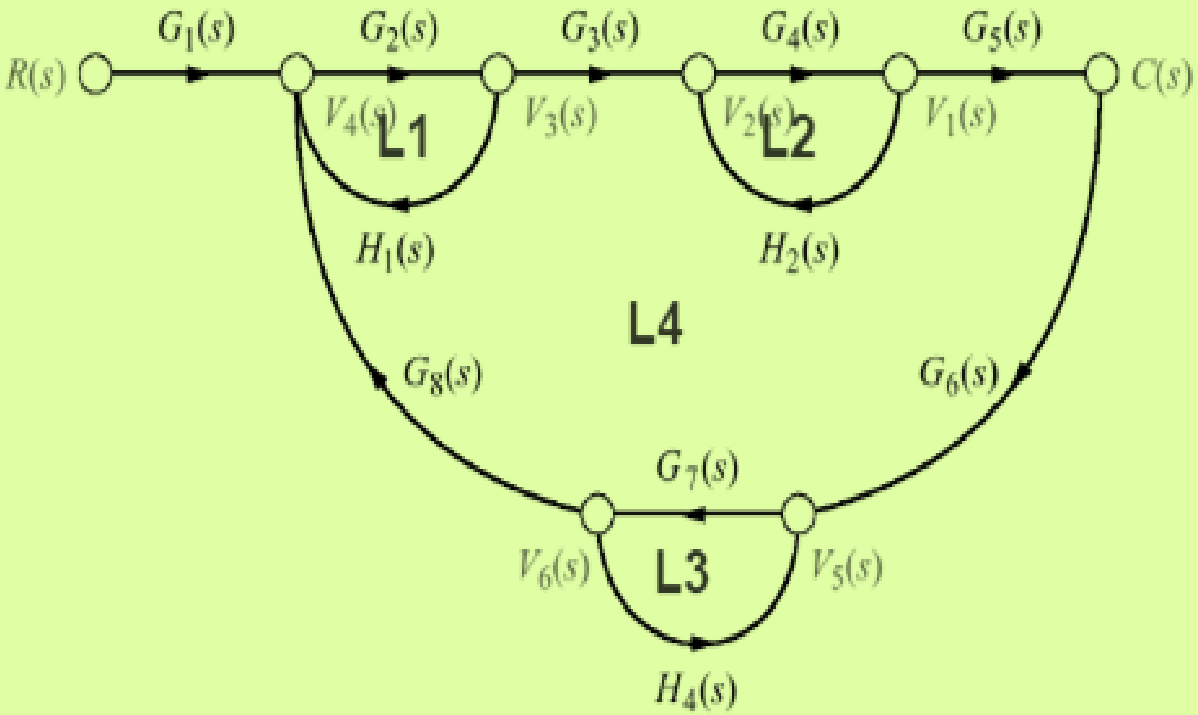
L1. $G_2(s)H_1(s)$

L2. $G_4(s)H_2(s)$

L3. $G_7(s)H_4(s)$

L4. $G_2(s)G_3(s)G_4(s)G_5(s)G_6(s)G_7(s)G_8(s)$

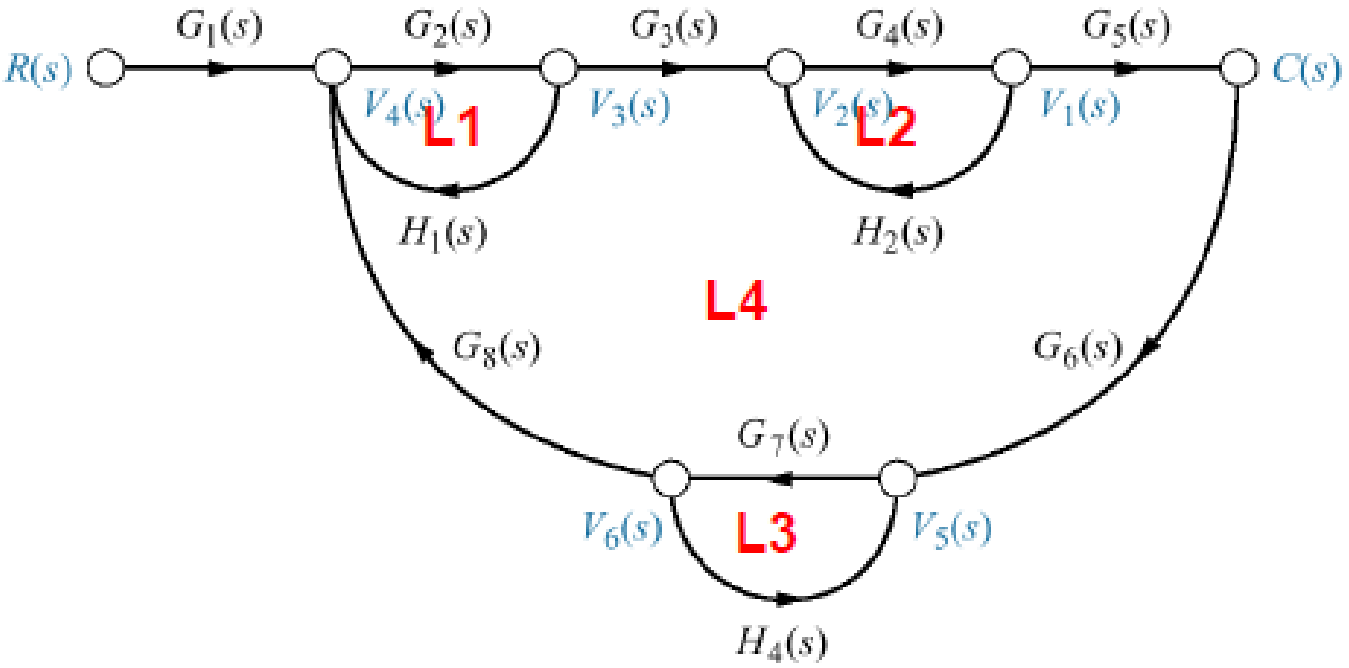
Third, identify the **non-touching loops taken two at a time**.



L1 and L2: $G_2(s)H_1(s)G_4(s)H_2(s)$ L2 and L3: $G_4(s)H_2(s)G_7(s)H_4(s)$

L1 and L3: $G_2(s)H_1(s)G_7(s)H_4(s)$

Finally, identify the **non-touching loops taken three at a time**.



L1, L2, L3: $G_2(s)H_1(s)G_4(s)H_2(s)G_7(s)H_4(s)$

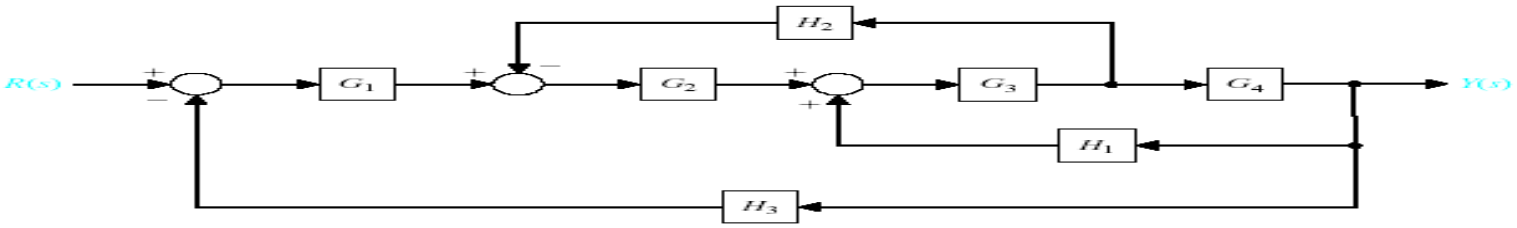
Now, form the Δ and Δk.

$$\begin{aligned}\Delta = 1 - [&G_2(s)H_1(s) + G_4(s)H_2(s) \\ &+ G_7(s)H_4(s) + G_2(s)G_3(s)G_4(s)G_5(s)G_6(s)G_7(s)G_8(s)] \\ &+ [G_2(s)H_1(s)G_4(s)H_2(s) + G_2(s)H_1(s)G_7(s)H_4(s) \\ &+ G_4(s)H_2(s)G_7(s)H_4(s)] \\ &- [G_2(s)H_1(s)G_4(s)H_2(s)G_7(s)H_4(s)]\end{aligned}$$

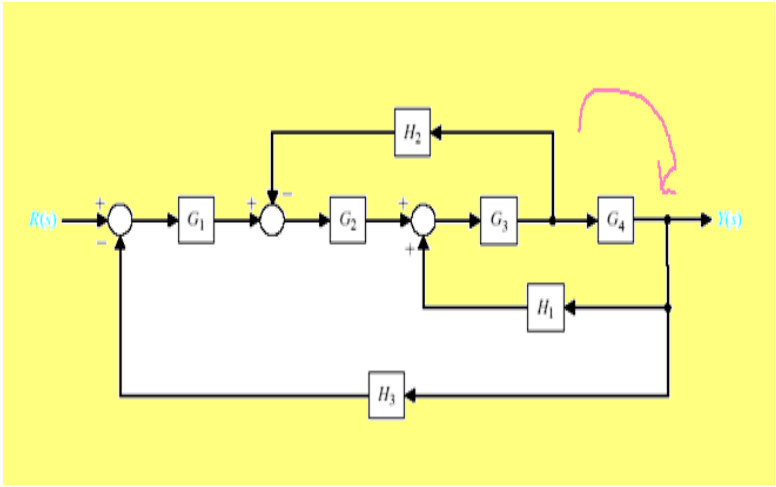
Δk is formed by [1 – loop does not touch forward path]

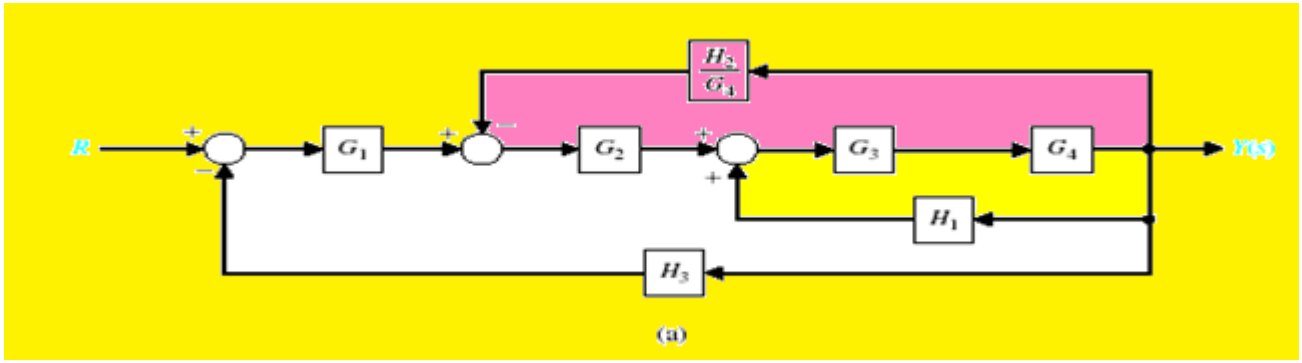
$$\Delta_1 = 1 - G_7(s)H_4(s)$$

Example of block diagram

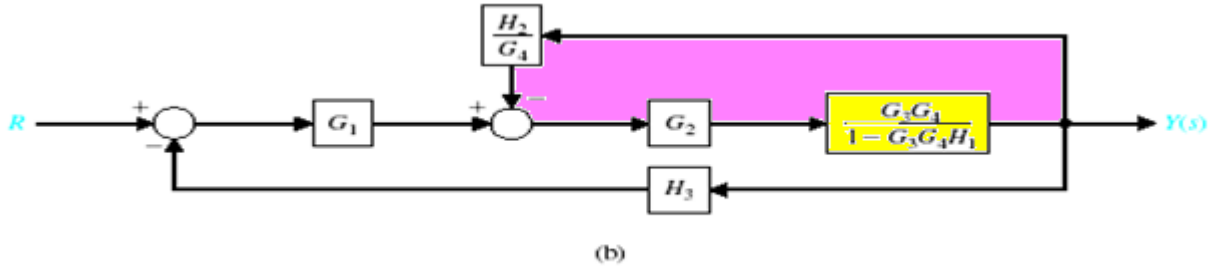


Step 1: Shift take off point from position before a block G_4 to position after block G_4

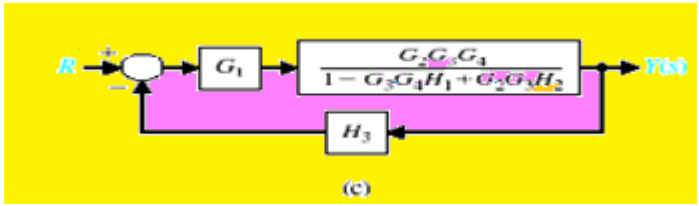




Step2 : Solve Yellow block.



Step3: Solve pink block.



Step4: Solve pink block.

(d)

Thanks