

Feedback System (H.1)

Signal Flow Graphs

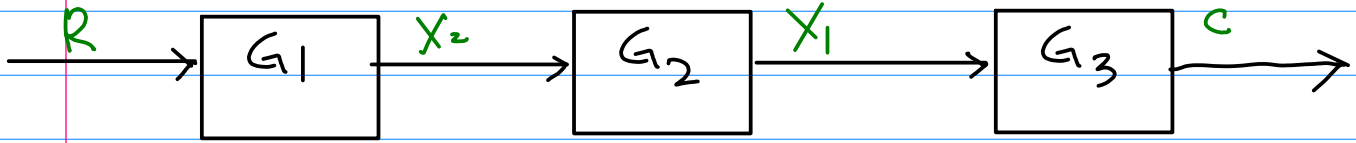
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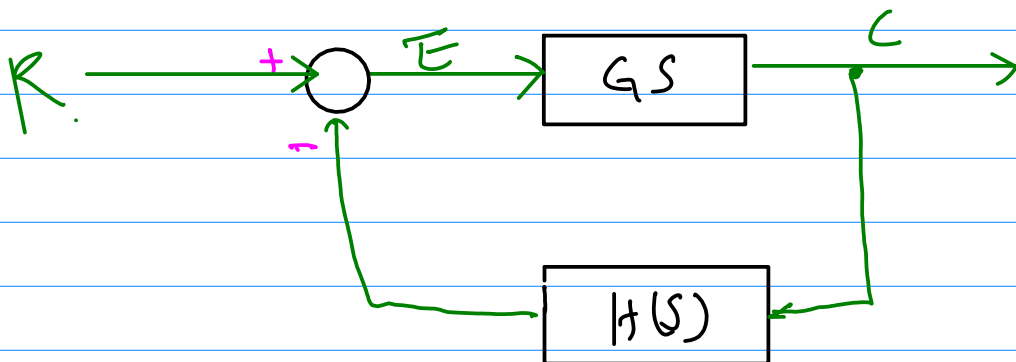
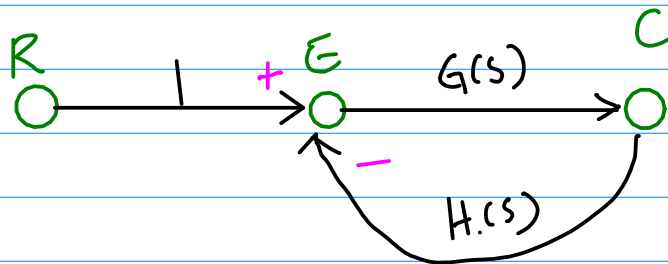
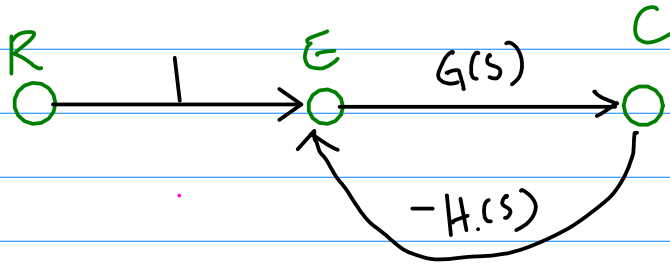
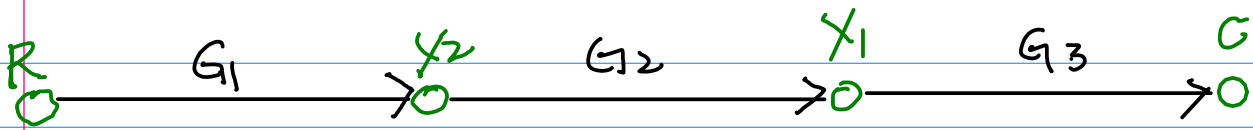
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Block Diagram & Signal Flow Graph

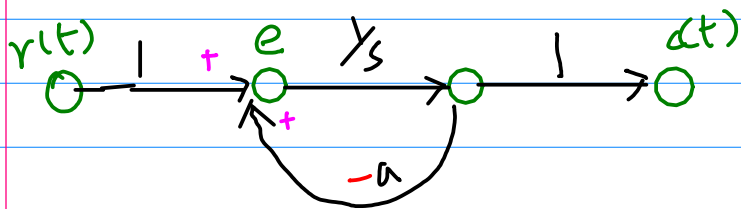
Block Diagram



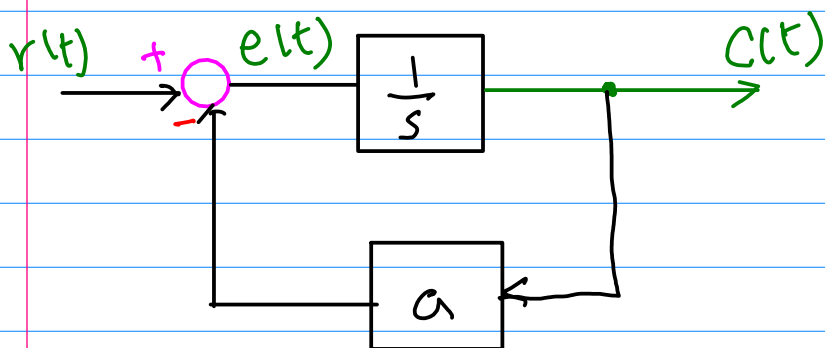
Signal Flow Graph.



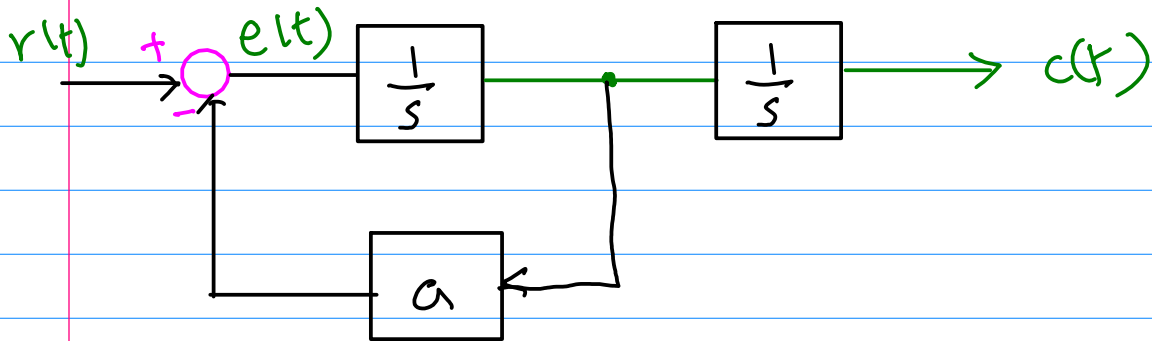
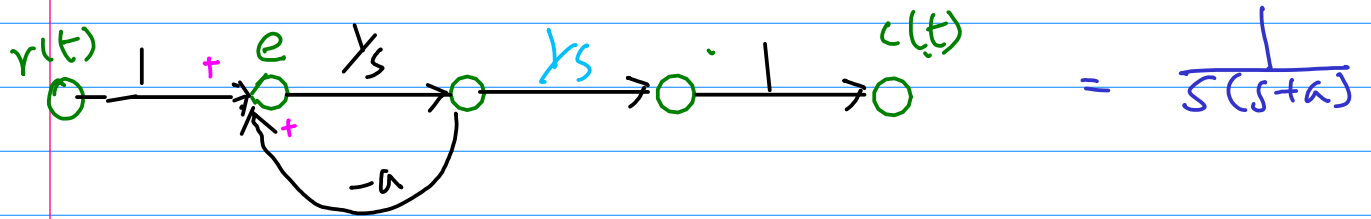
p48 . 22) 3.16

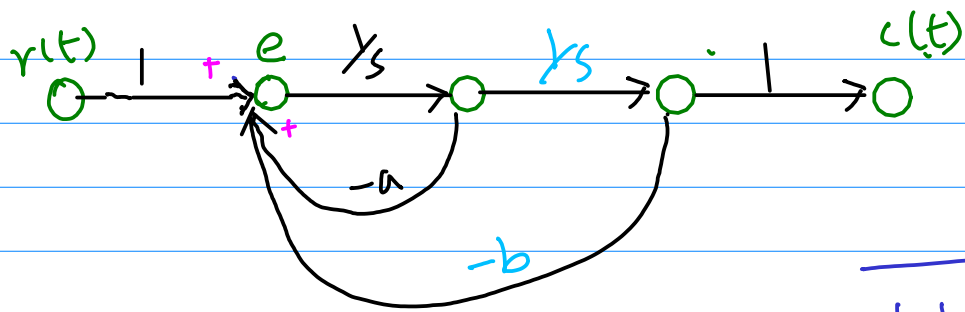


$$\frac{1/s}{1 + a/s} = \frac{1}{s+a}$$

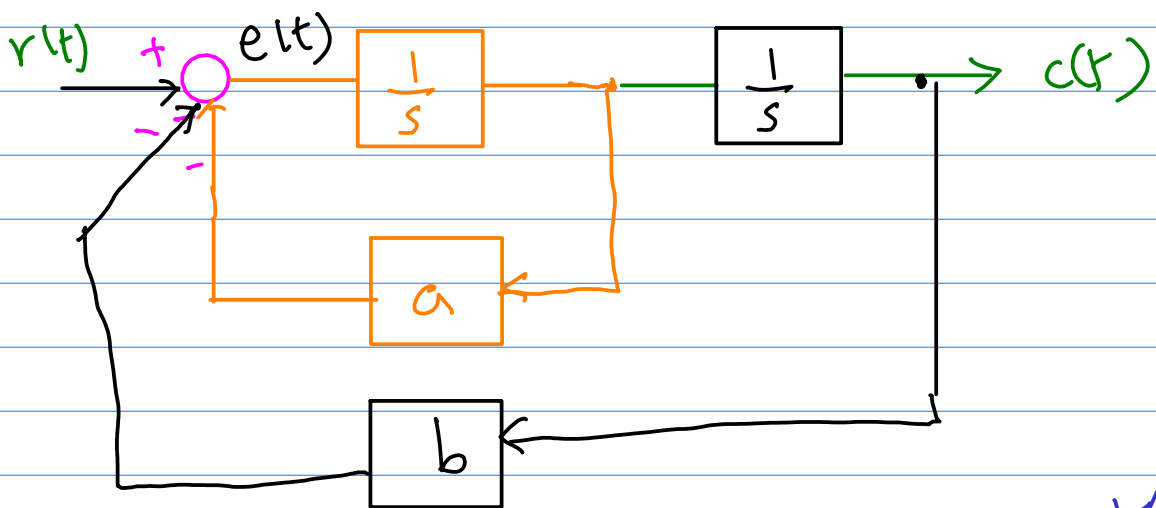


$$\frac{1}{s+a} \times \frac{1}{s}$$



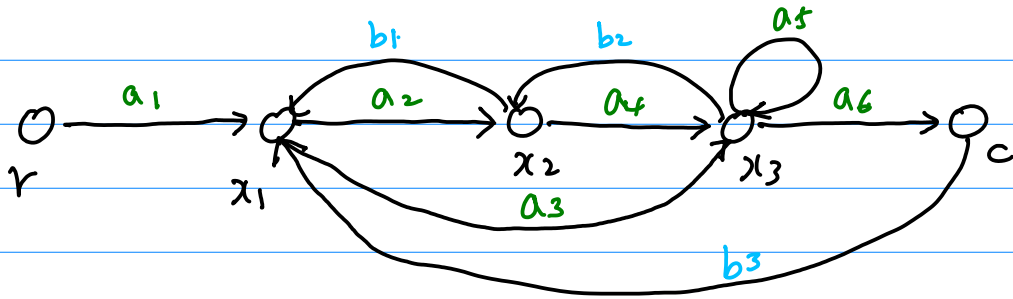


$$\frac{\frac{1}{s+a} \cdot \frac{1}{s}}{1 + b \frac{1}{s+a} \cdot \frac{1}{s}}$$



$$\frac{1}{(s+a)s + b} = \frac{1}{s^2 + as + b}$$

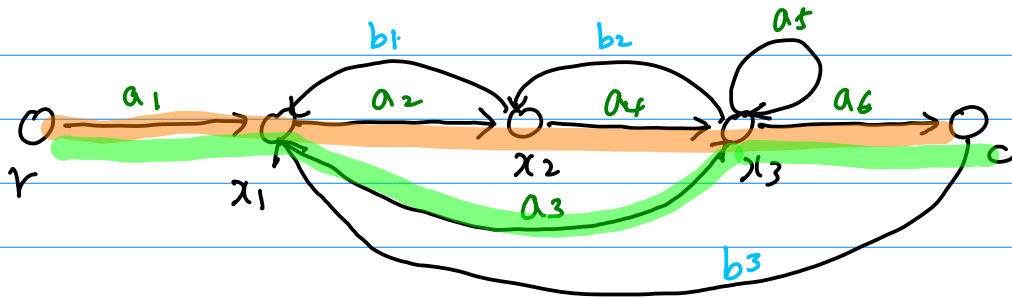
* Mason's Rule



$$G = \frac{1}{\Delta} \sum_{k=1}^N G_k \Delta_k$$

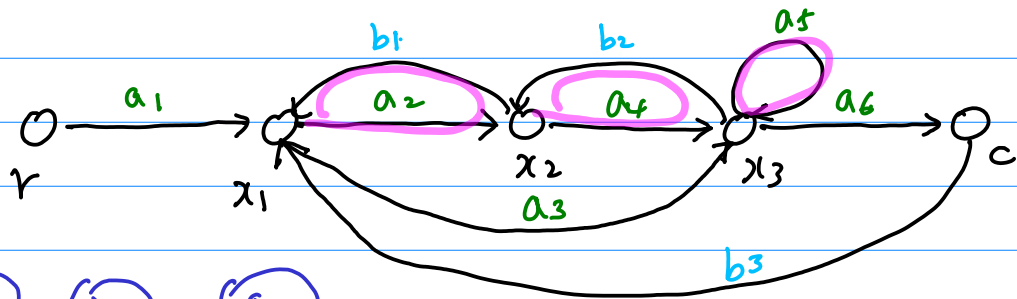
$$\Delta = 1 \ominus \sum_l L_{l1} \oplus \sum_m L_{m2} \ominus \sum_n L_{n3} \oplus \dots$$

Forward path

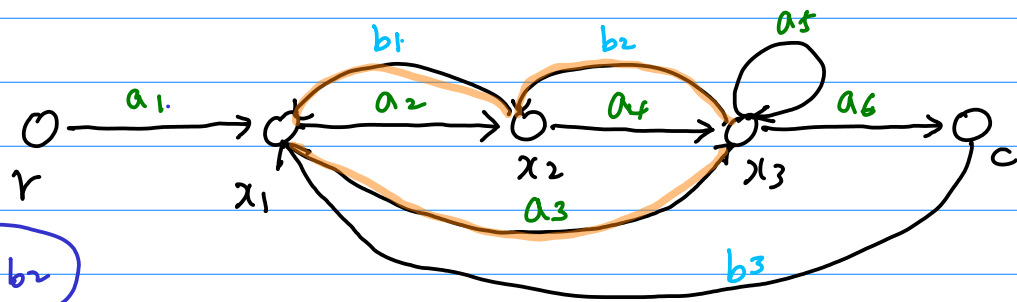


all the non-touching loops

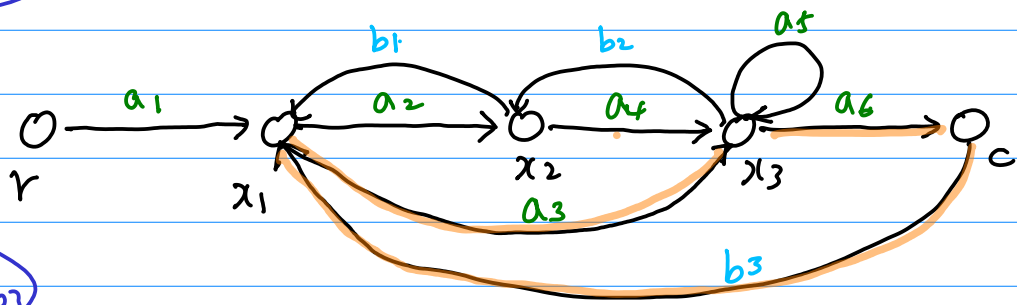
K=6 loops



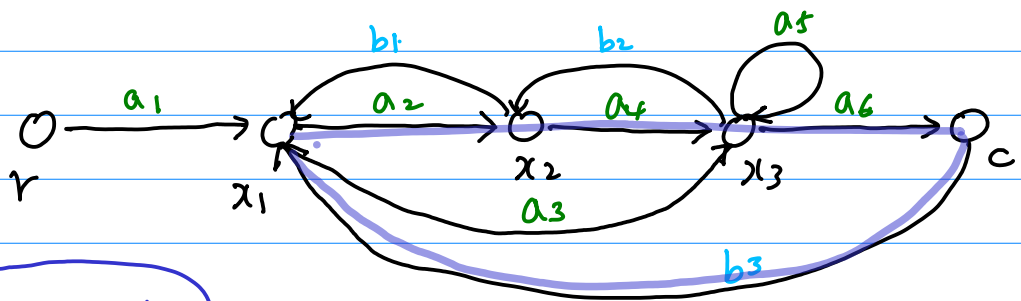
loop gain $(b_1), (b_2), (a_5)$



$(a_3 b_1 b_2)$



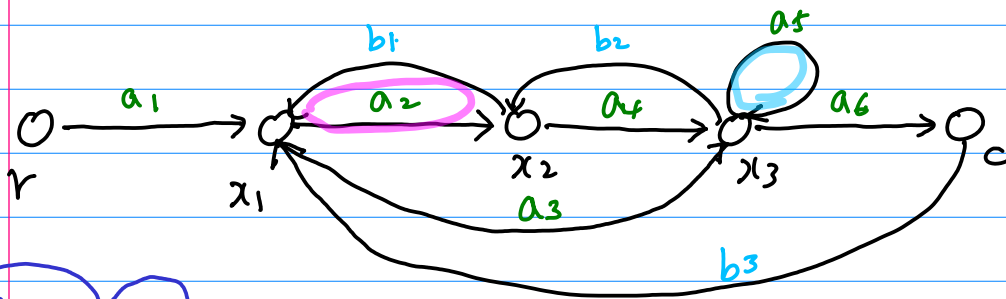
$(a_3 a_1 b_3)$



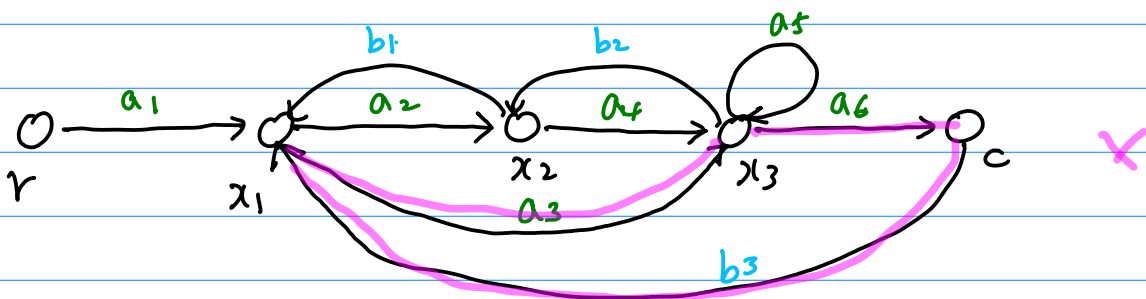
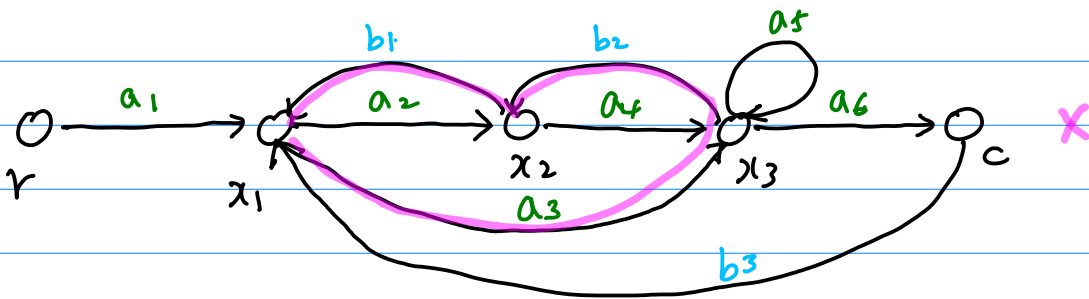
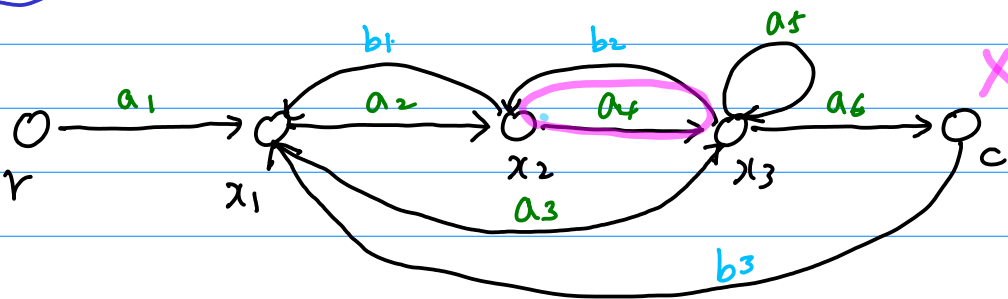
$(a_2 a_4 a_6 b_3)$

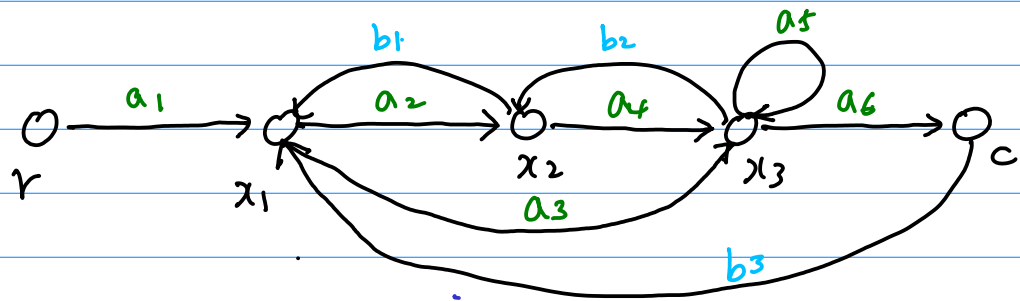
non-touching

2 loop^z of combination
& Gain

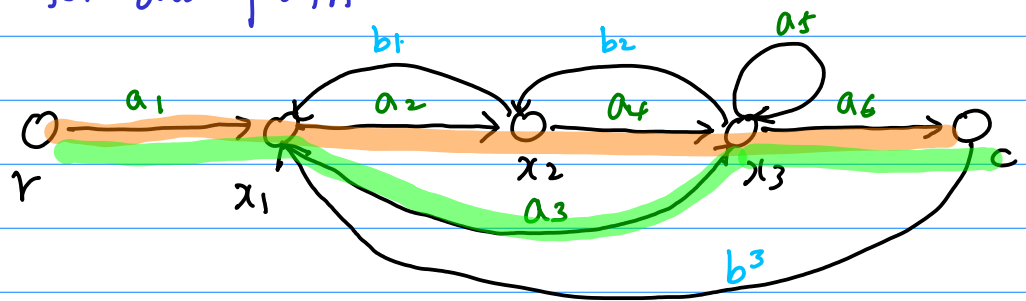


$a_2 b_1$ a_5





$N=2$ में forward path



$$G_1 = [a_1 \ a_2 \ a_4 \ a_6]$$

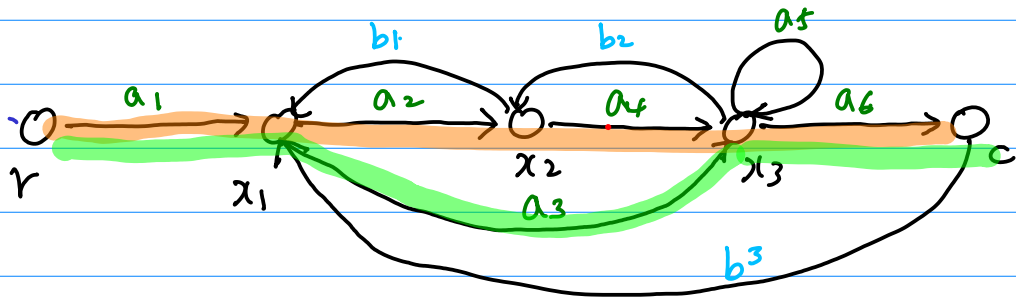
$$G_2 = [a_1 \ a_3 \ a_6]$$

$N=2$. # of forward paths

k : forward path index $k=1, 2$

$K=6$ 총 loop의 갯수

$$G = \frac{1}{\Delta} \sum_{k=1}^N G_k \Delta_k$$



$k=1$ $G_1 = a_1 a_2 a_4 a_6$ forward path 1 gain

$k=2$ $G_2 = a_1 a_3 a_6$ forward path 2 gain

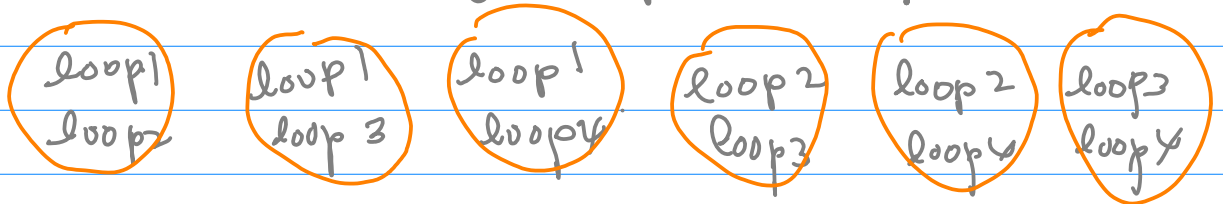
$$\Delta = 1 \ominus \sum_l L_l \oplus \sum_m L_m^2 \ominus \sum_n L_n^3 \oplus \dots$$

not touching
loop ① only combination
loop ② only combination
loop ③ only combination

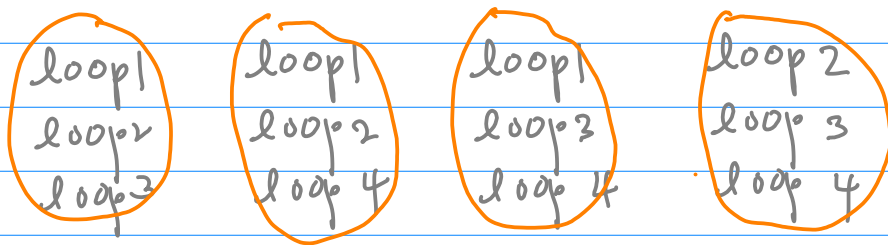
L1 loop 1 개씩 combination



L2 non-touching loop 2 개씩 combination



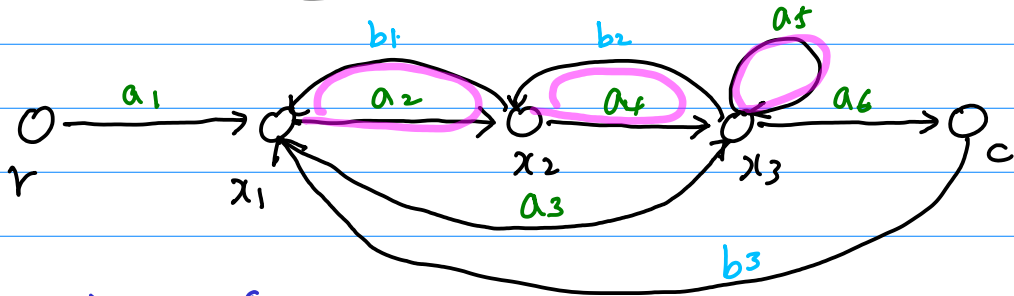
L3 non-touching loop 3 개씩 combination



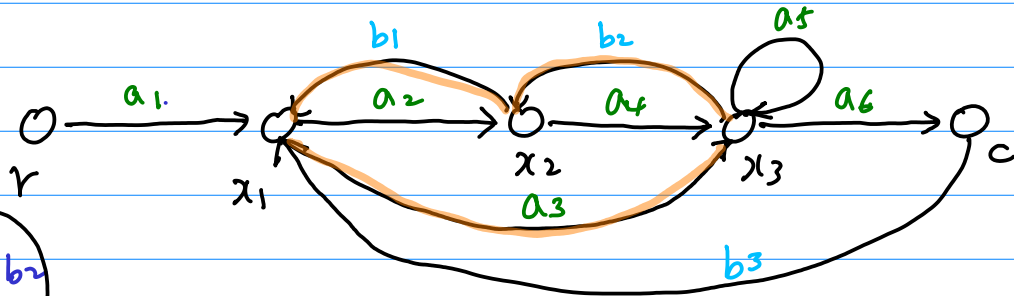
L_{21} loops | 개씩 combination

loop gain

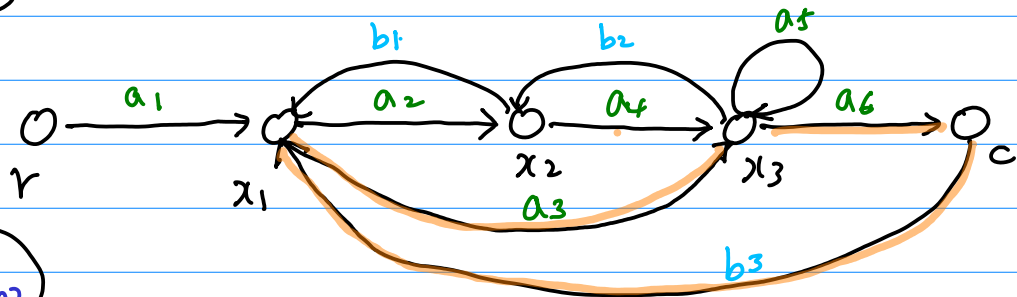
$L_{21} = a_2 b_1$ $L_{31} = a_4 b_2$ $L_{11} = a_5$



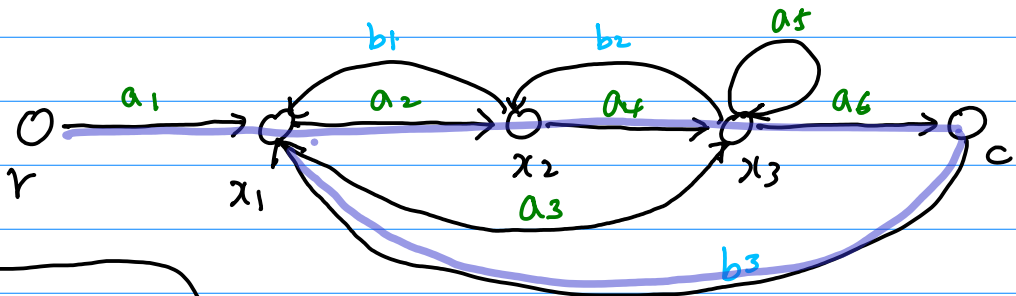
loop gain b_1, b_2, a_5



$L_{41} = a_3 b_1 b_2$



$L_{51} = a_3 a_1 b_3$



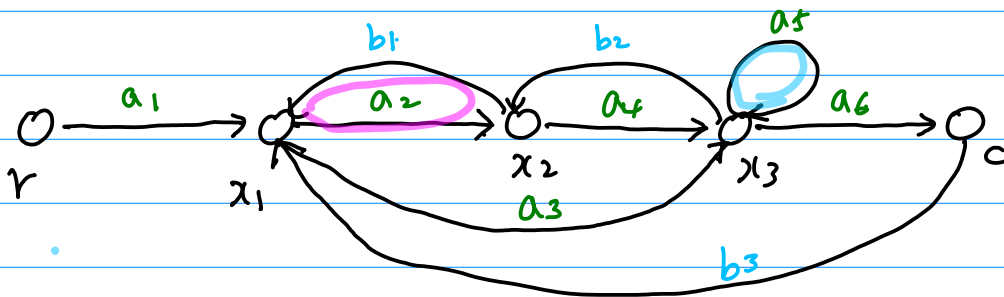
$L_{61} = a_2 a_4 a_1 b_3$

L_{22} non-touching loop 2 개씩 combination

loop gain

$$L_{21} = a_2 b_1$$

$$L_{11} = a_5$$



$$L_{12} = L_{11} L_{21} = a_2 a_5 b_1$$

$$\Delta = 1 \ominus \sum_l L_{l1} \oplus \sum_m L_{m2} \ominus \sum_n L_{n3} \oplus \sum L$$

not touching
loop ① $n=1$ combination
loop ② $n=2$ combination
loop ③ $n=3$ combination

$$\Delta = 1 \ominus \sum_l L_{l1} \oplus \sum_m L_{m2} \ominus \sum_n L_{n3} \oplus \sum L$$

$$= 1 \ominus \sum_l L_{l1} \oplus \sum_m L_{m2}$$

$$= 1 - (L_{11} + L_{21} + L_{31} + L_{41} + L_{51})$$

$$+ (L_{12})$$

$$\Delta = 1 - (a_1 + a_2 b_1 + a_4 b_1 + a_3 b_1 b_2 + a_3 a_6 b_3 + a_2 a_4 a_6 a_3) + (a_2 a_5 b_1)$$

$$G = \frac{1}{\Delta} \sum_{k=1}^N G_k \Delta_k$$

Δ_1 = terms in Δ that are non-touching forward path 1

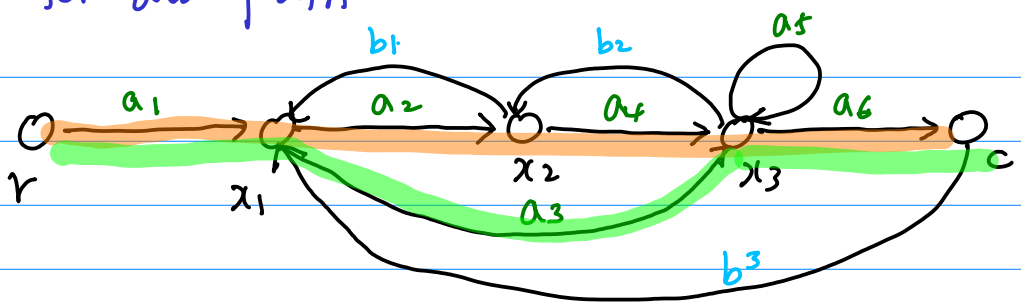
Δ_2 = terms in Δ that are non-touching forward path 2

$$\Delta = 1 \ominus \sum_l L_l \oplus \sum_m L_m^2 \ominus \sum_n L_n^3 \oplus \sum L$$

⋮
⋮
⋮
⋮

not touching
loop ① non-touching combination
loop ② non-touching combination
loop ③ non-touching combination

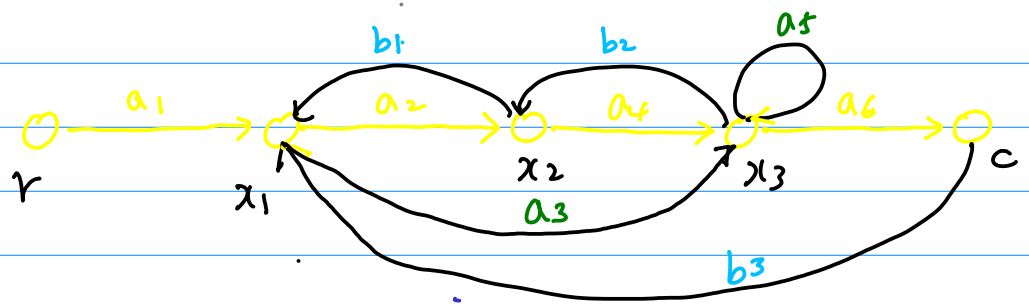
$N=2$ 개의 forward path



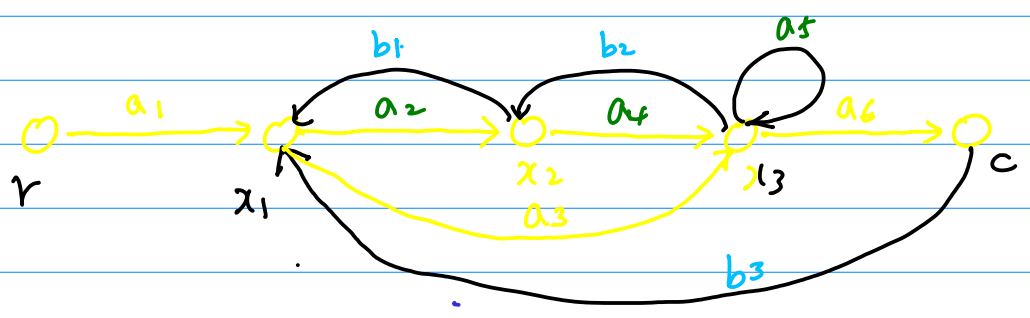
$$G_1 = [a_1 \ a_2 \ a_4 \ a_6]$$

$$G_2 = [a_1 \ a_3 \ a_6]$$

$\Delta_1 = \Delta$ that are non-touching forward path 1
 $= 1$ (no such loop)



$\Delta_2 = \Delta$ that are non-touching forward path 2
 $= 1$ (no such loop)



$$G = \frac{1}{\Delta} \sum_{k=1}^N G_k \Delta_k$$

$$= \frac{1}{\Delta} (G_1 \Delta_1 + G_2 \Delta_2)$$

$$= \frac{1}{\Delta} (a_1 a_2 a_4 a_6 + a_1 a_3 a_6)$$

=

