Electrical Engineering

Electronics and Communication Engineering

Control System

Lecture No.-1

Block Diagram Reduction Part-I

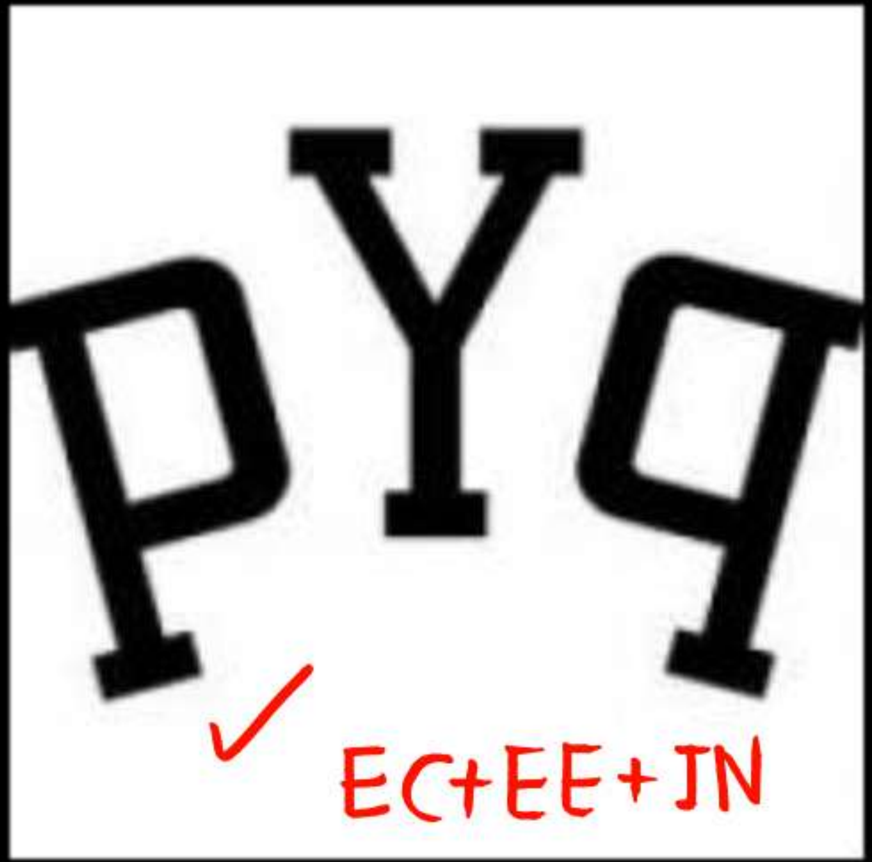
By- Vishal Soni Sir

1. Block Diagram Representation
2. Summer Point
3. Take Off Point
4. Rules for Block Diag. Reduction

Syllabus

1. Block Diagram & SFG
2. Basic of Signals
3. Time Response Analysis
4. Routh Hurwitz Criteria
5. Root Locus
6. Frequency Response Analysis
7. Bode Plot
8. Nyquist Plot
9. State Space Analysis
10. Mathematical Modelling

Resource

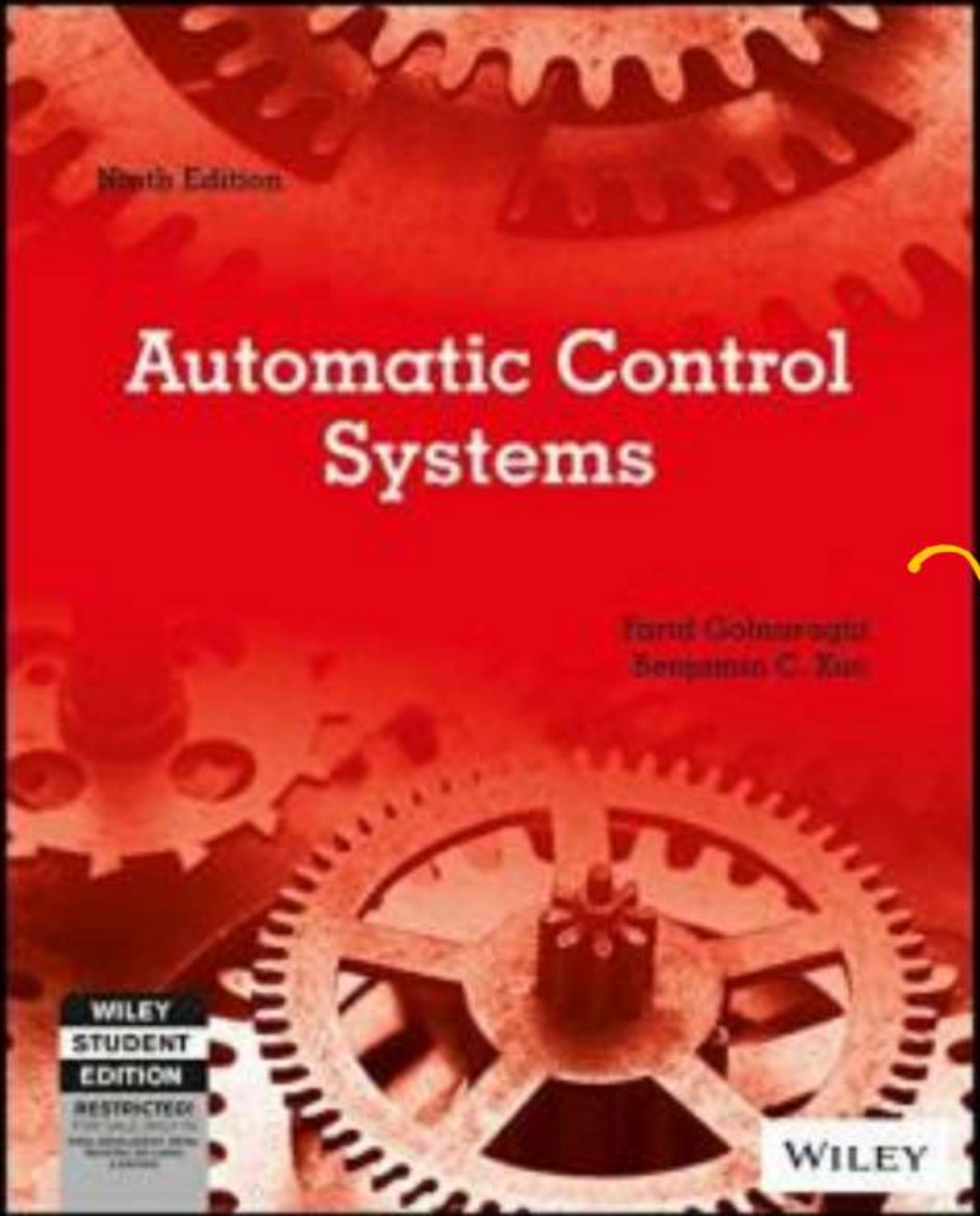


(Test Series)

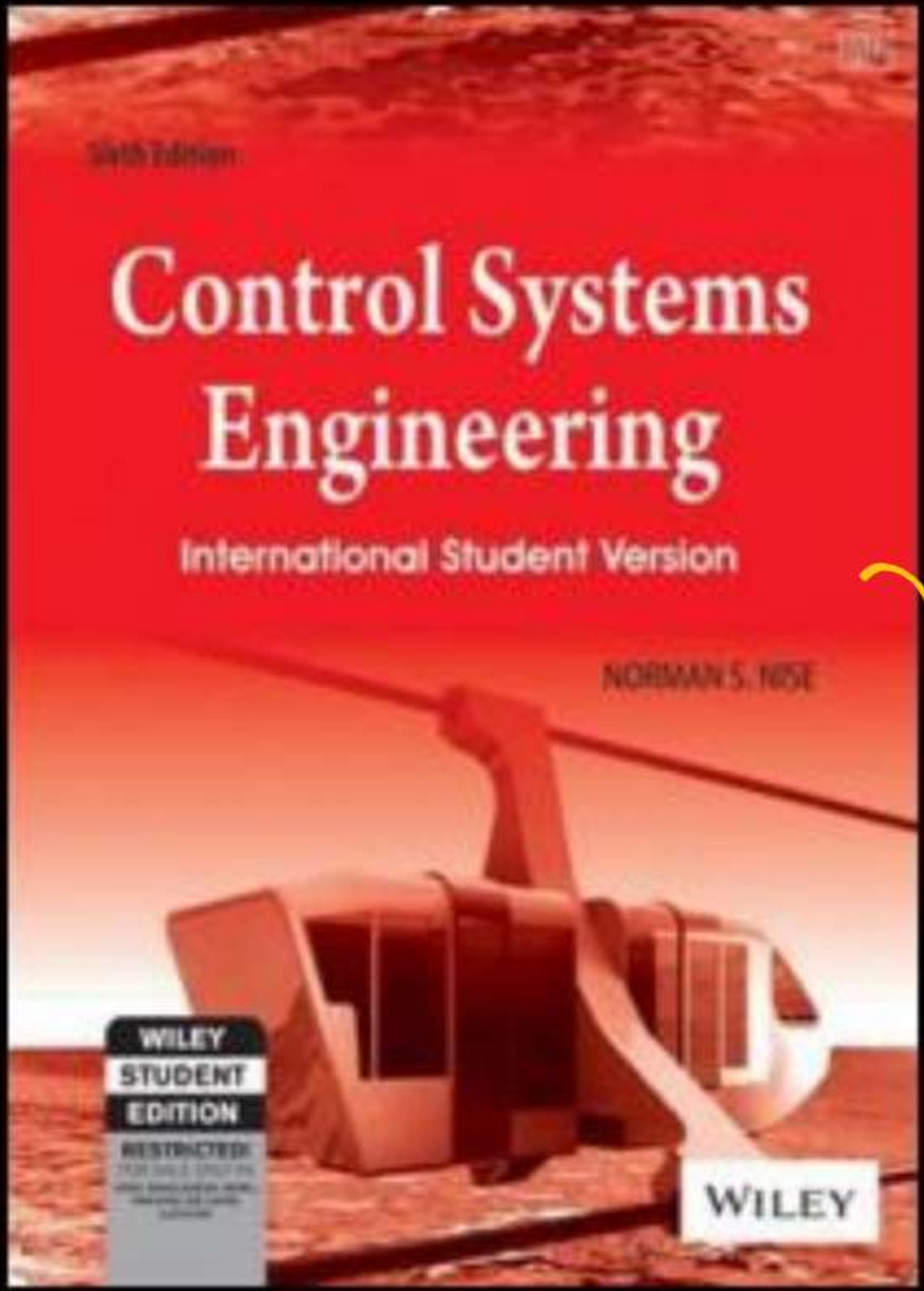
Test Series

$\boxed{\text{(SUNDAY)}}$

Books



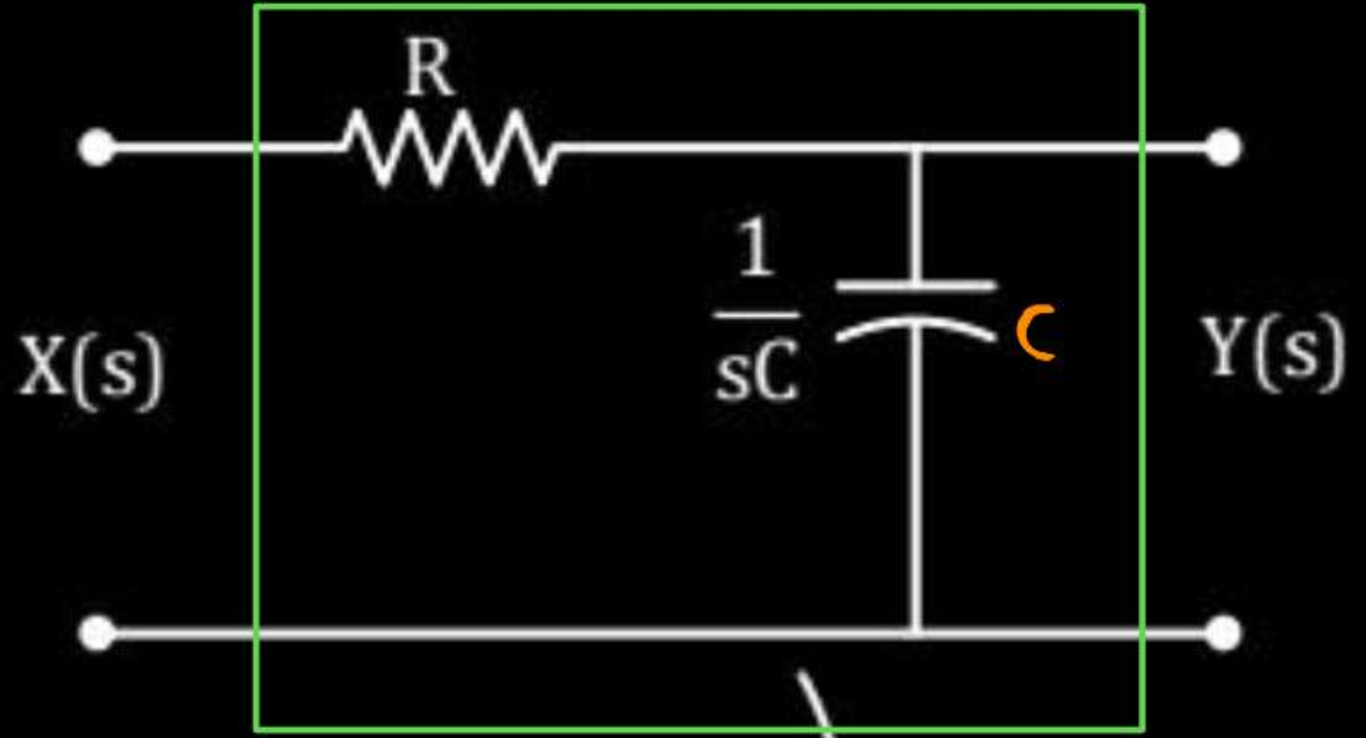
B.C. KUO

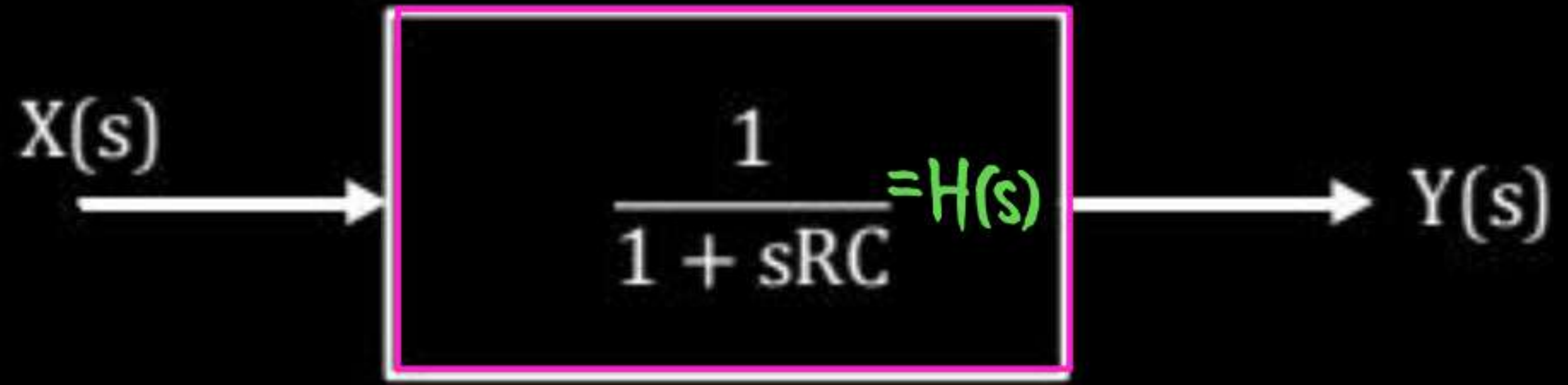


NORMAN NISE


probability
risk
opportunity
data
process
complex
customer
plan
planning
analysis
sales
impact
retention
project
assessment
performance
management
strategy
cost
evaluation
identification
research
treatment
plan
strategy
resources
risk
performance
context
evaluation
scope
important
data

Block Diagram Representation





$$\frac{Y(s)}{X(s)} = \frac{\frac{1}{sC}}{R + \frac{1}{sC}} = \frac{1}{1+sRC}$$

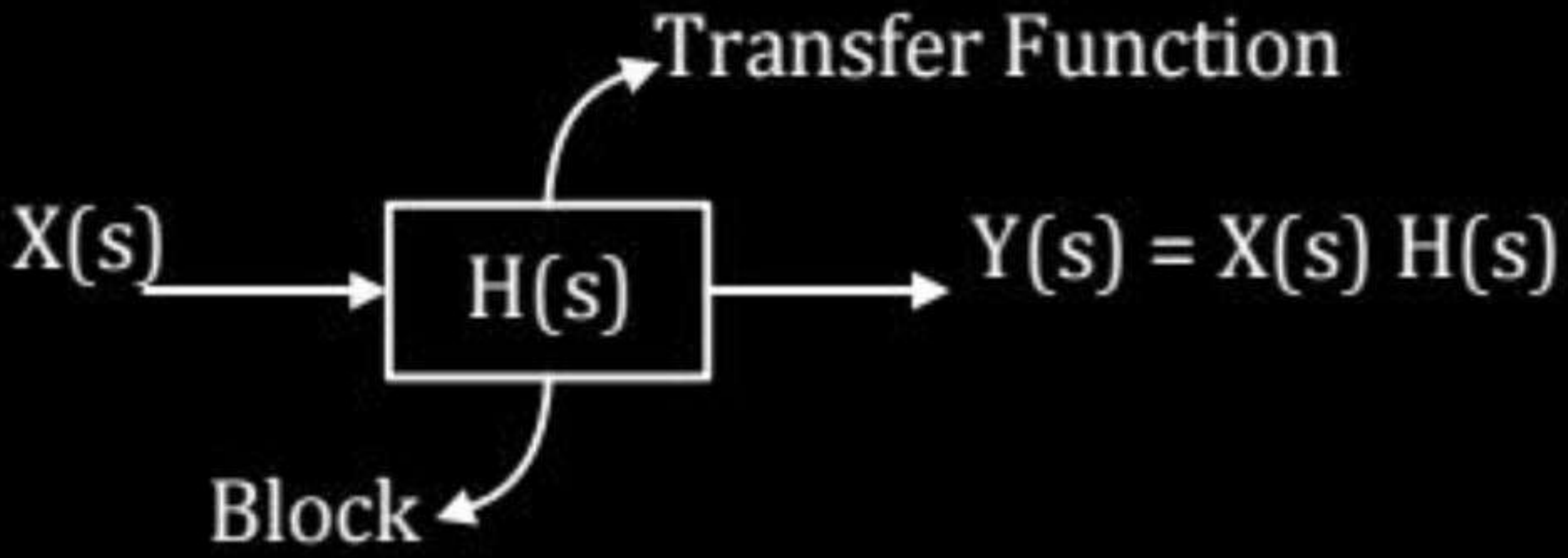
$$H(s) = \frac{1}{1+sRC}$$

$$x(t) \xleftrightarrow{L.T.} X(s)$$

$$y(t) \xleftrightarrow{L.T.} Y(s)$$

$$h(t) \xleftarrow{L.T.} H(s)$$

Block Diagram Representation



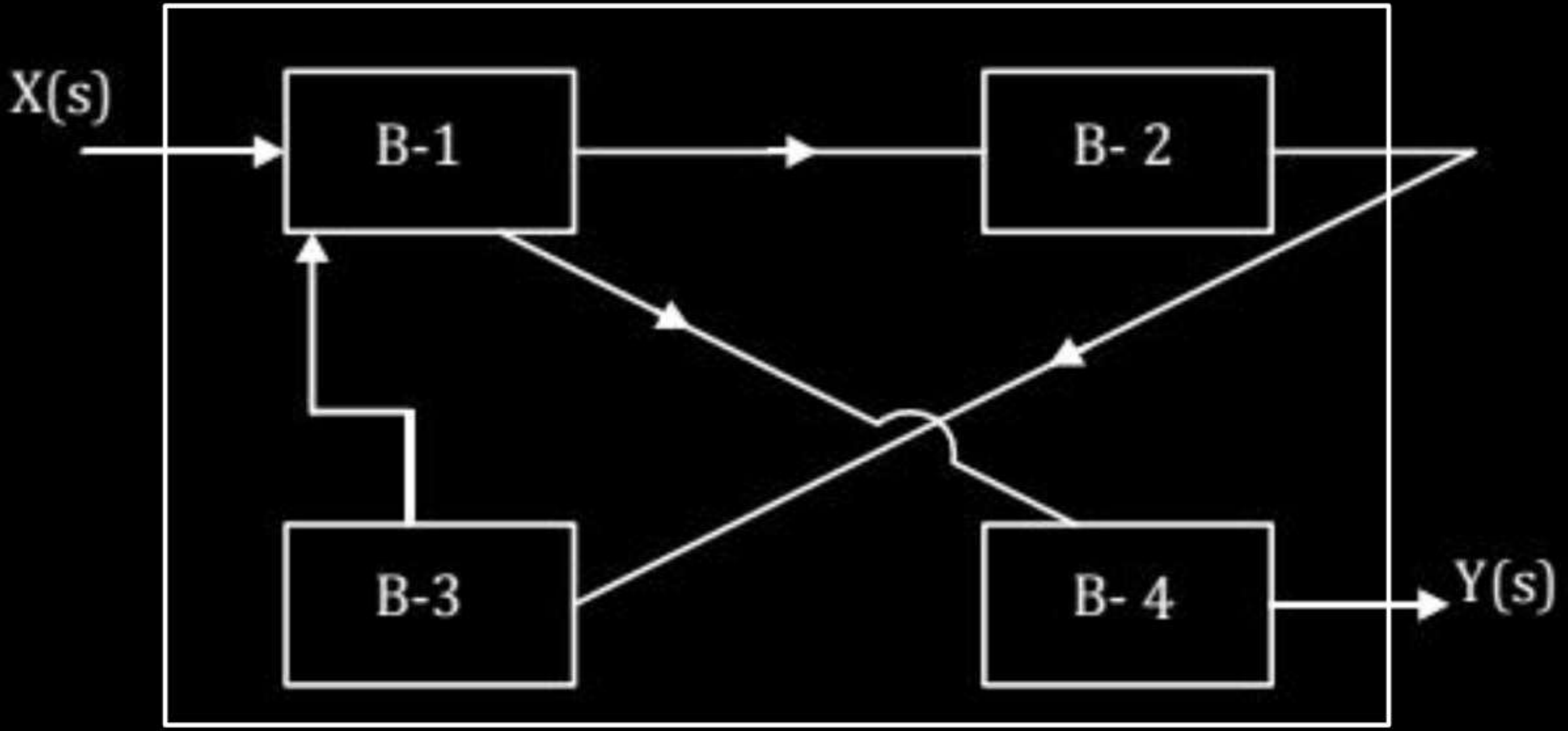
$X(s) \longrightarrow X$

$H(s) \longrightarrow G$

$Y(s) \longrightarrow Y$

1. Block diagram representation is used to represent a system.
2. By using block diagram representation, transfer function can be calculated.

Requirement : Block Diagram Reduction



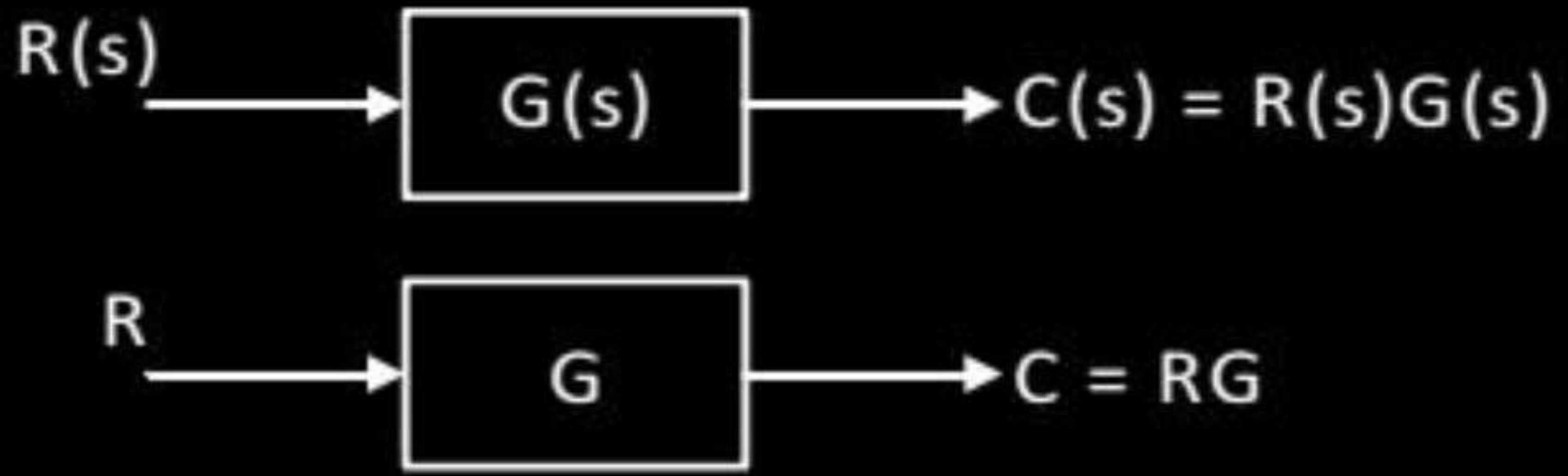
$\boxed{Y = BX}$

Notations

Input : $r(t) \leftrightarrow R(s)$

Output $c(t) \leftrightarrow C(s)$

Transfer Function $g(t) \leftrightarrow G(s)$

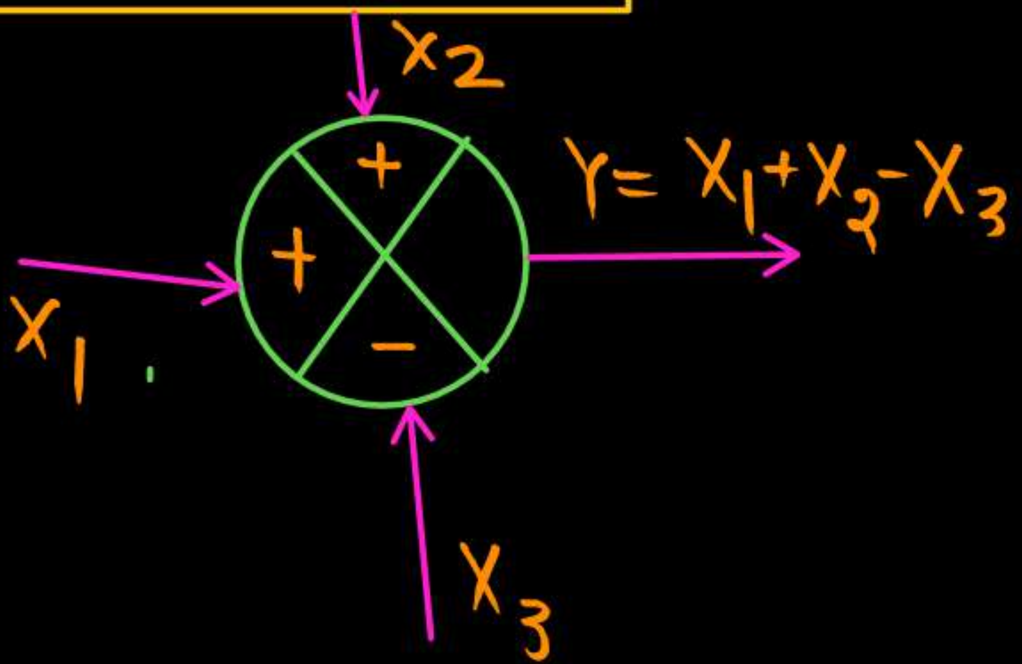


Important Component

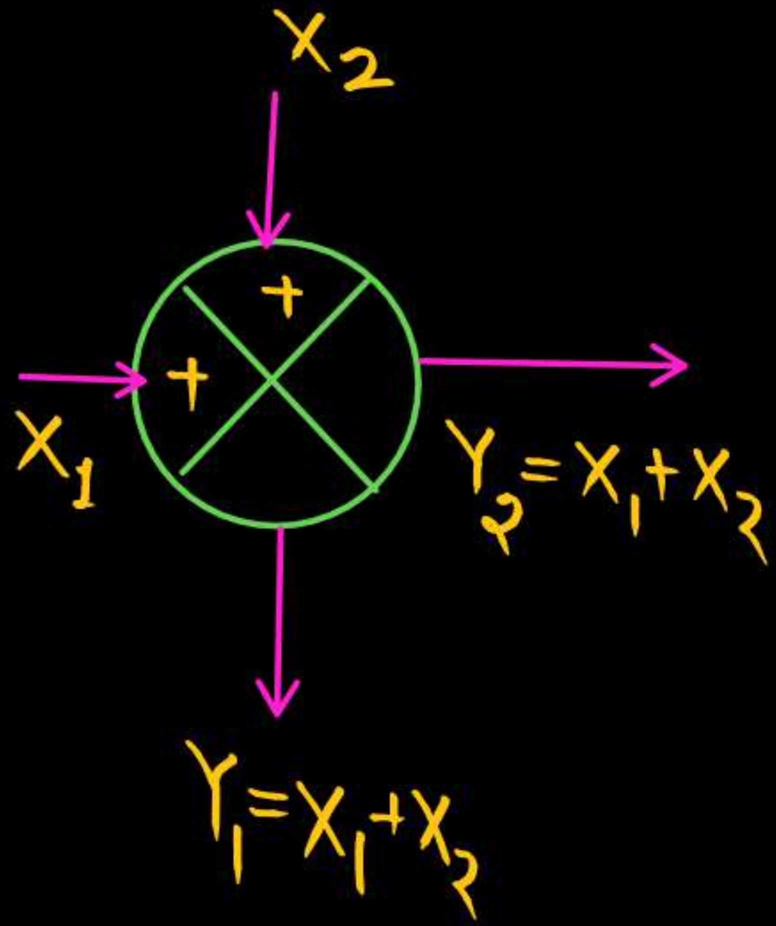
1. Summer :

It should have 2 or more than 2 inputs.

Multi Input Single output

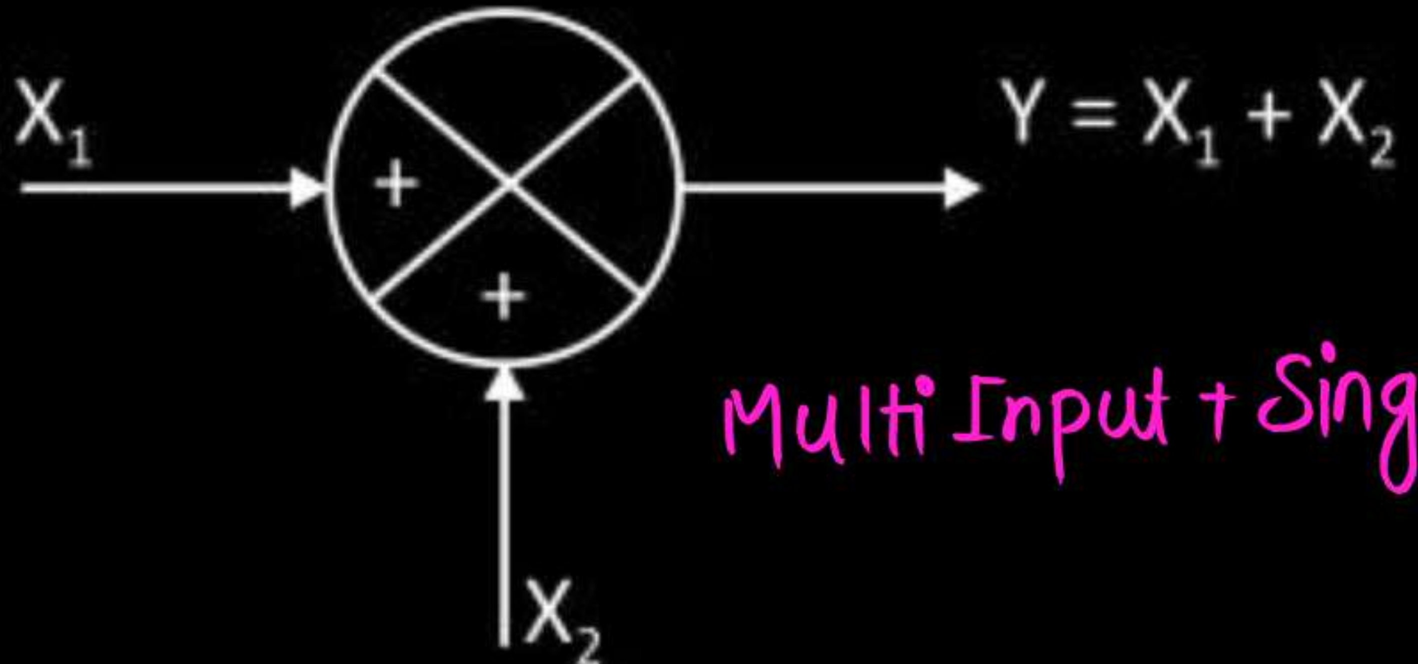


Multi Input Multi output



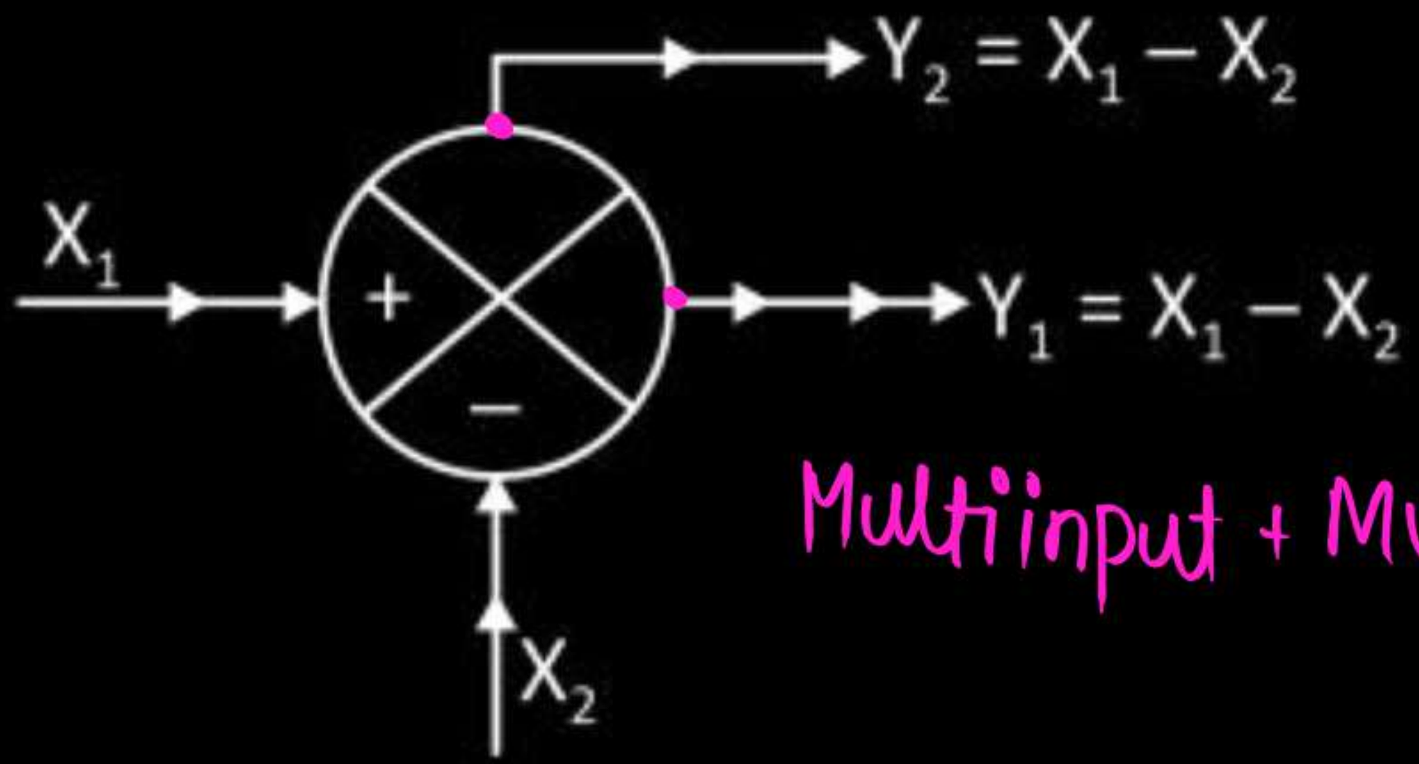
[**Symbol**]

1.



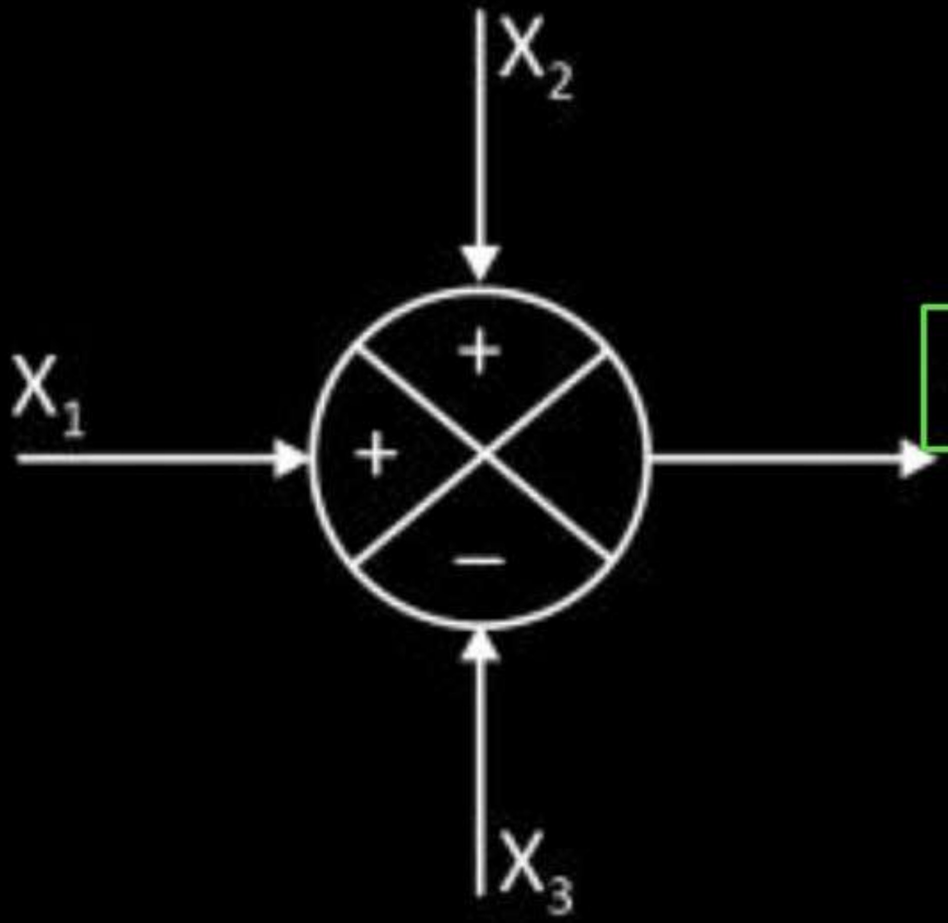
Multi Input + Single output

2.



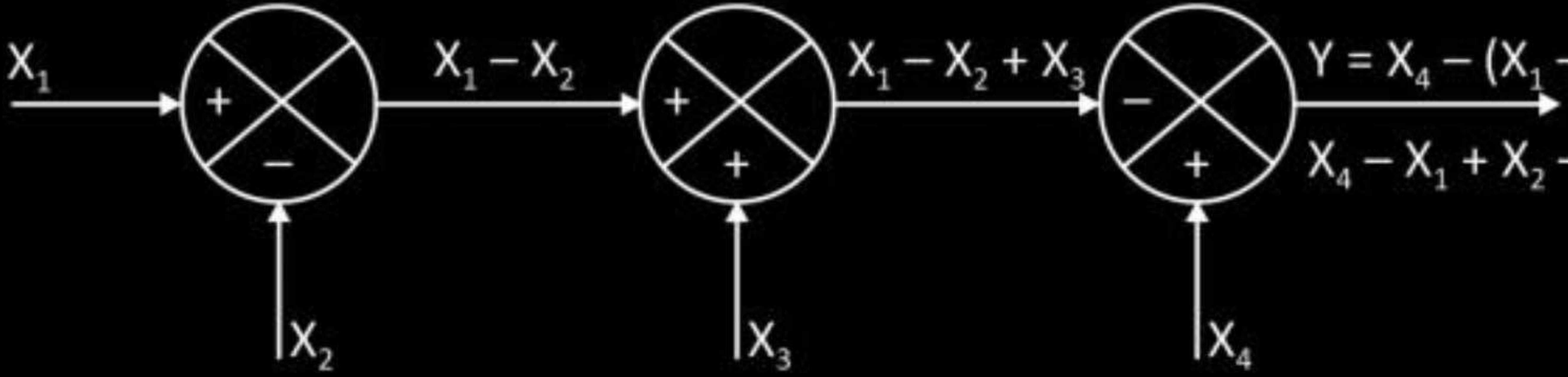
Multi input + Multi output

3.



$$\boxed{Y = X_1 + X_2 - X_3}$$

4.

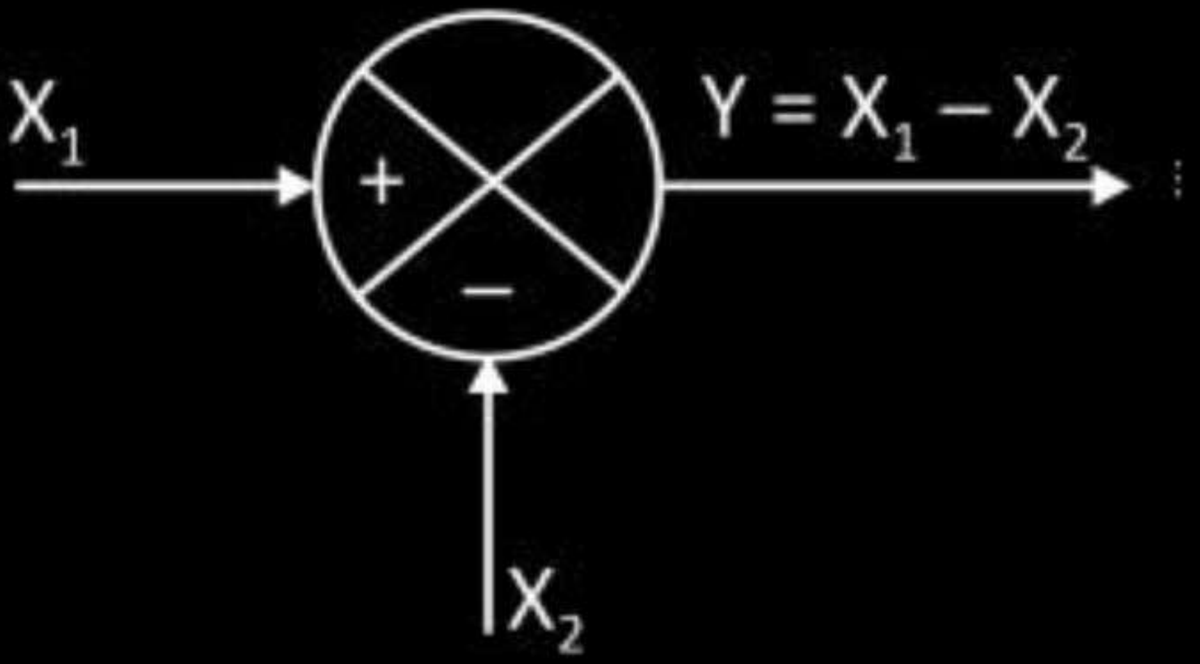


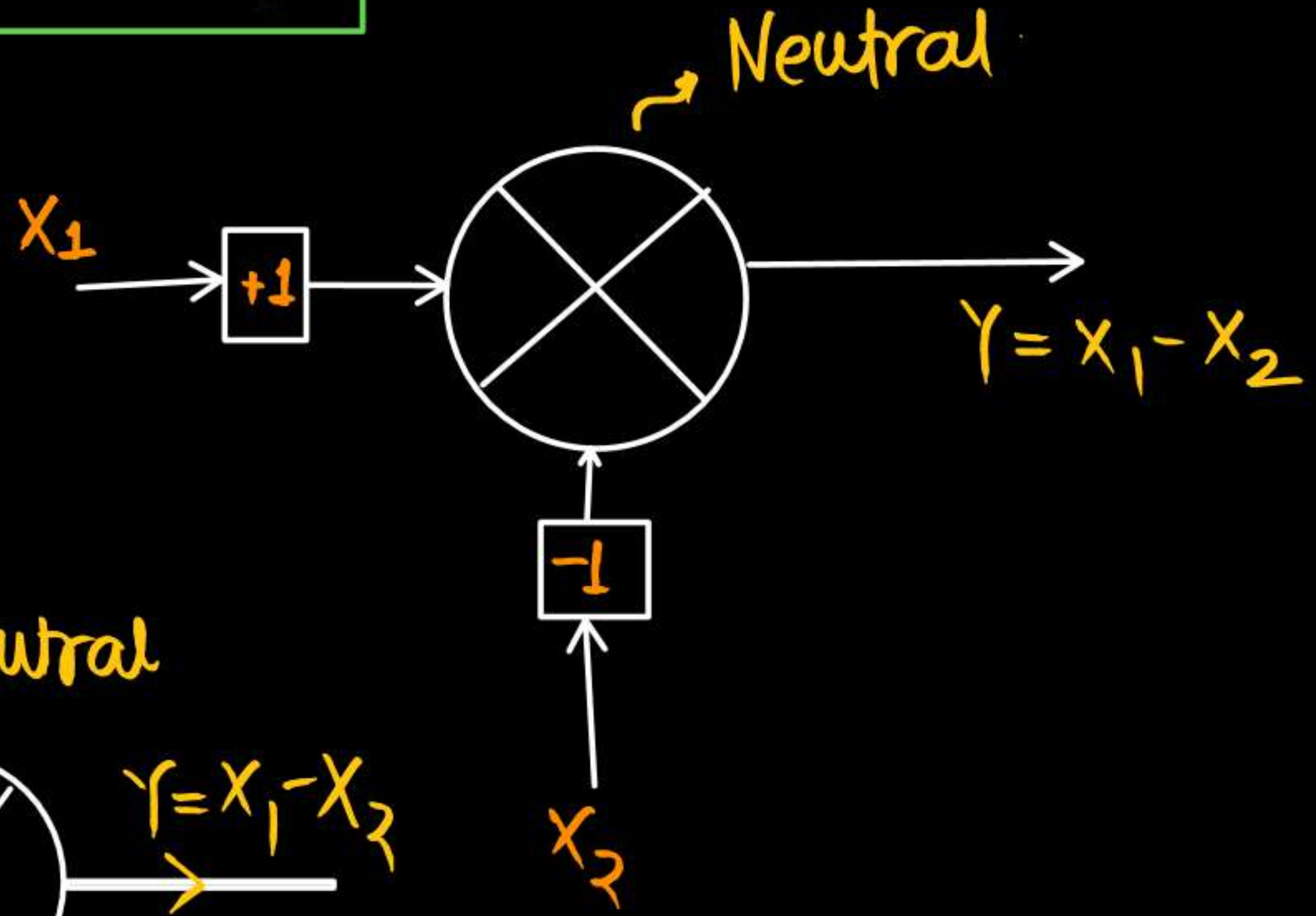
$Y = X_4 - (X_1 - X_2 + X_3)$

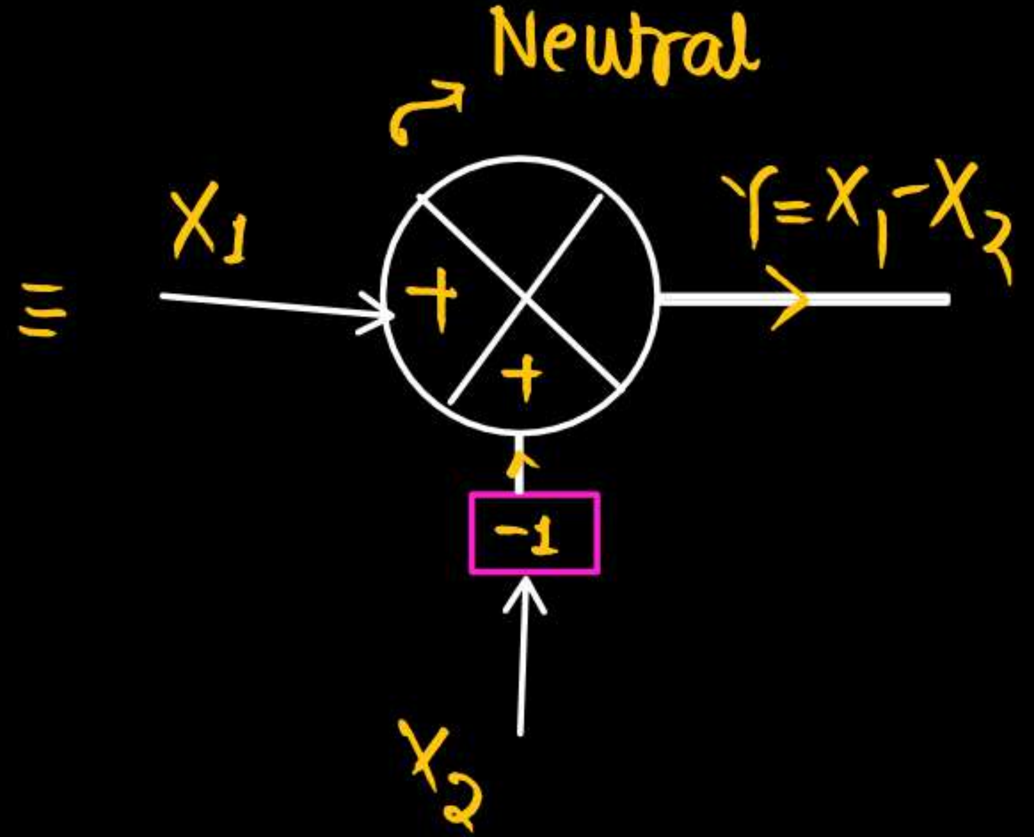
$X_4 - X_1 + X_2 - X_3 = Y$

Making a summer Block Neutral

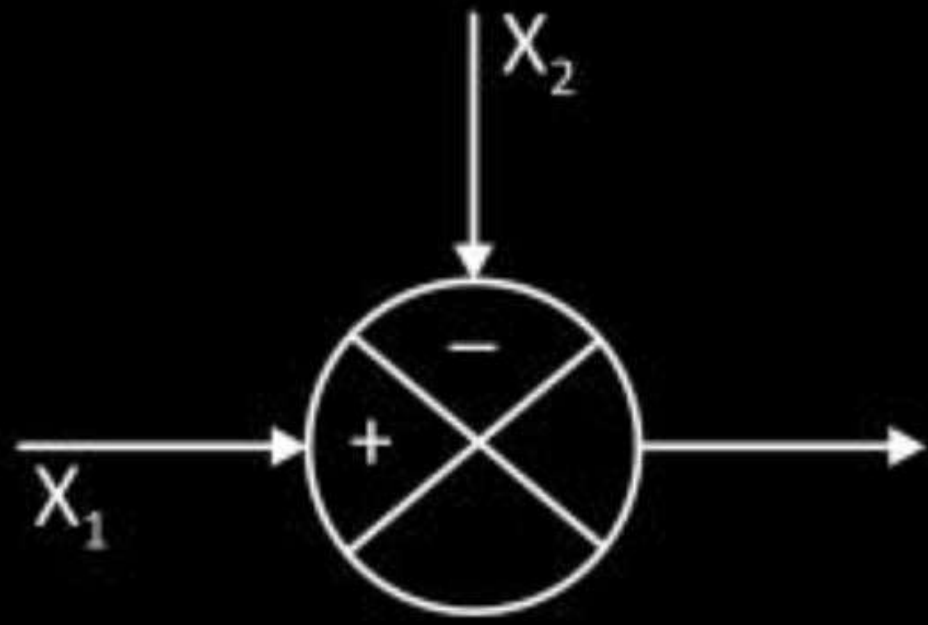
1.



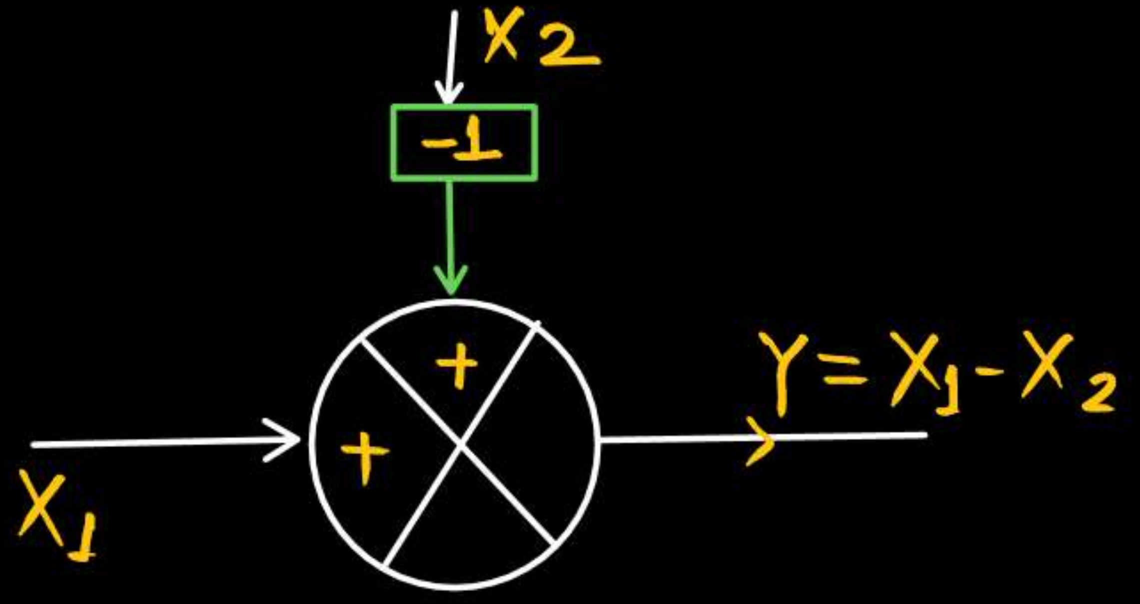




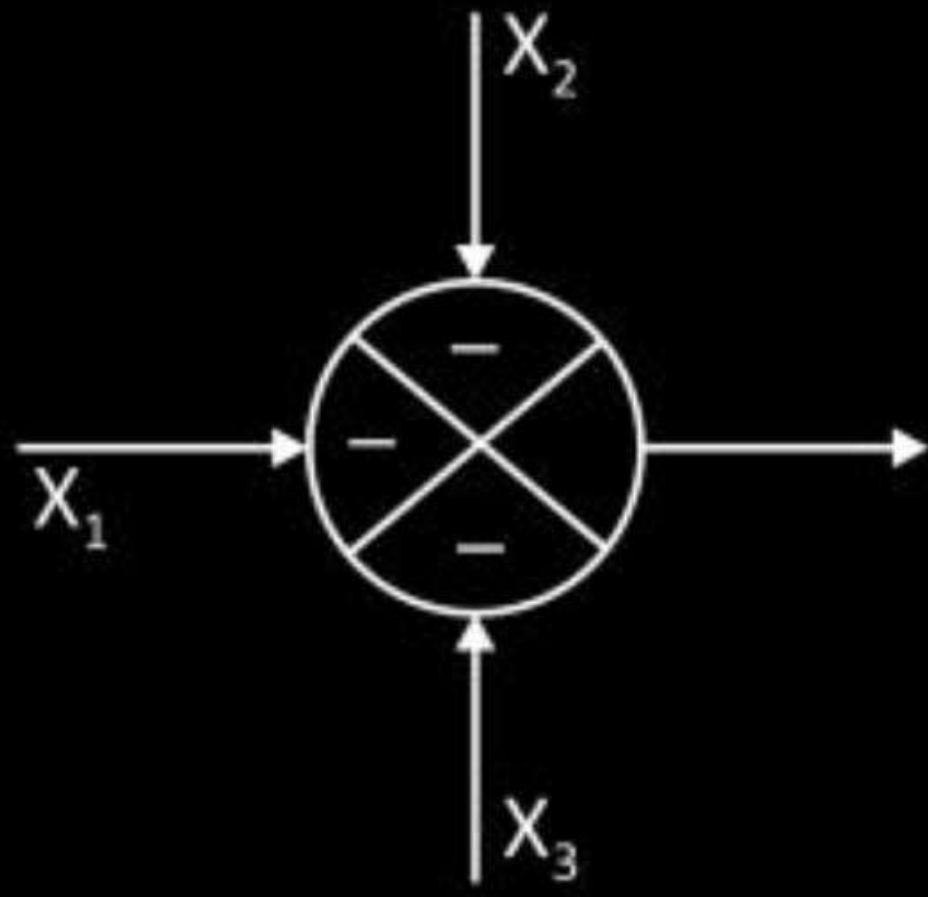
2.



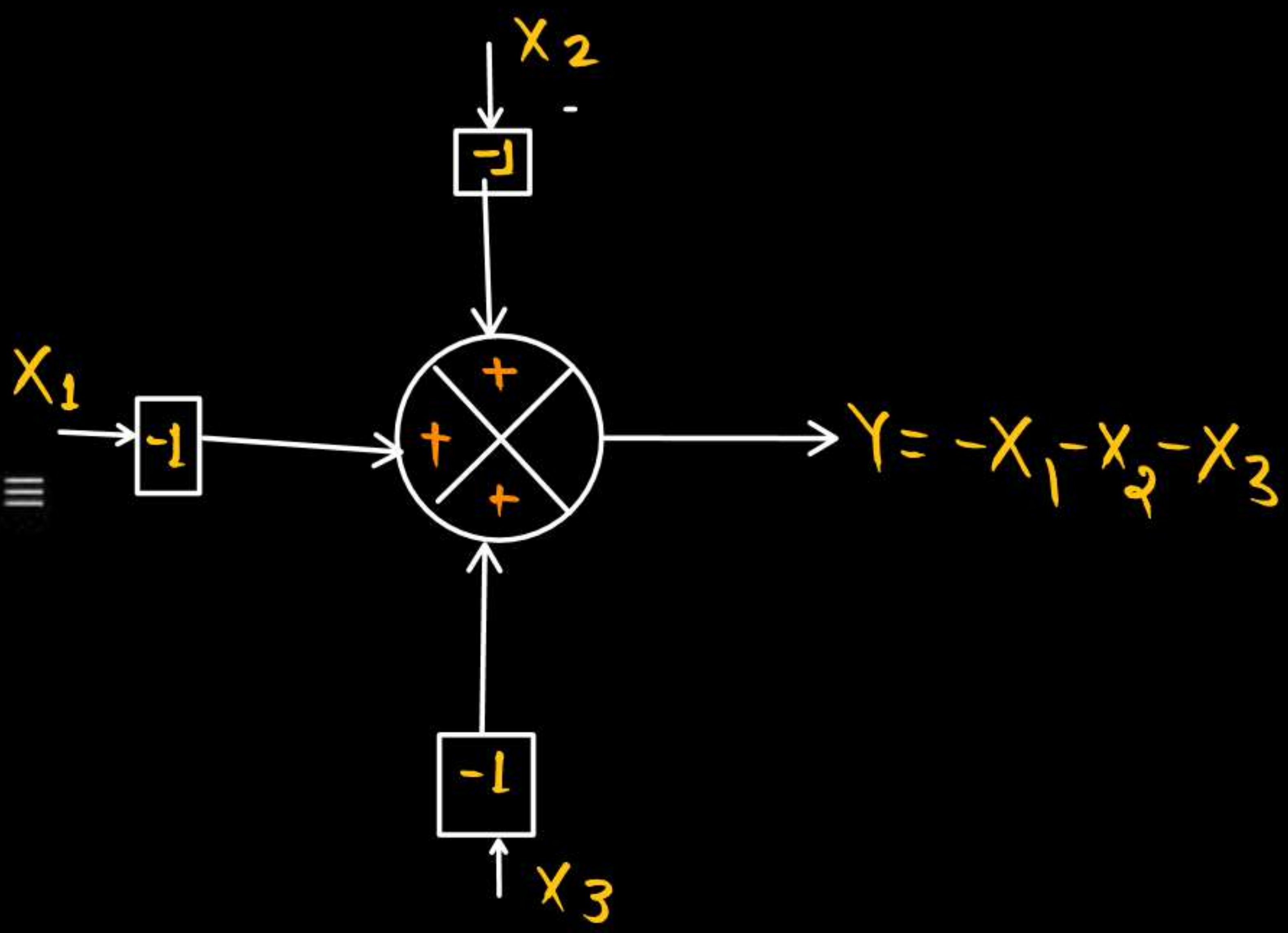
$Y \equiv$



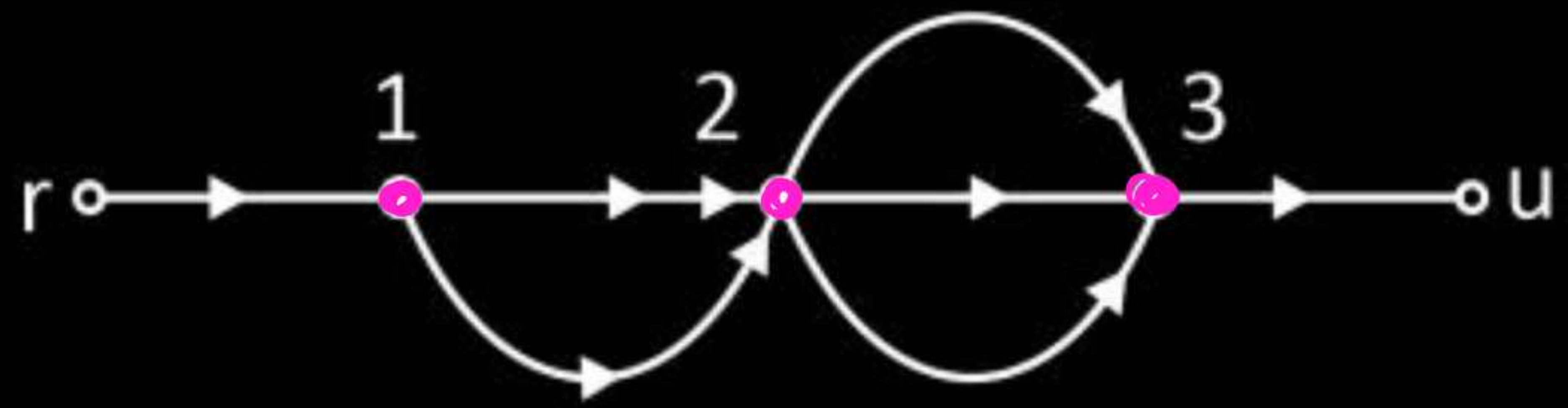
3.



$Y \equiv$

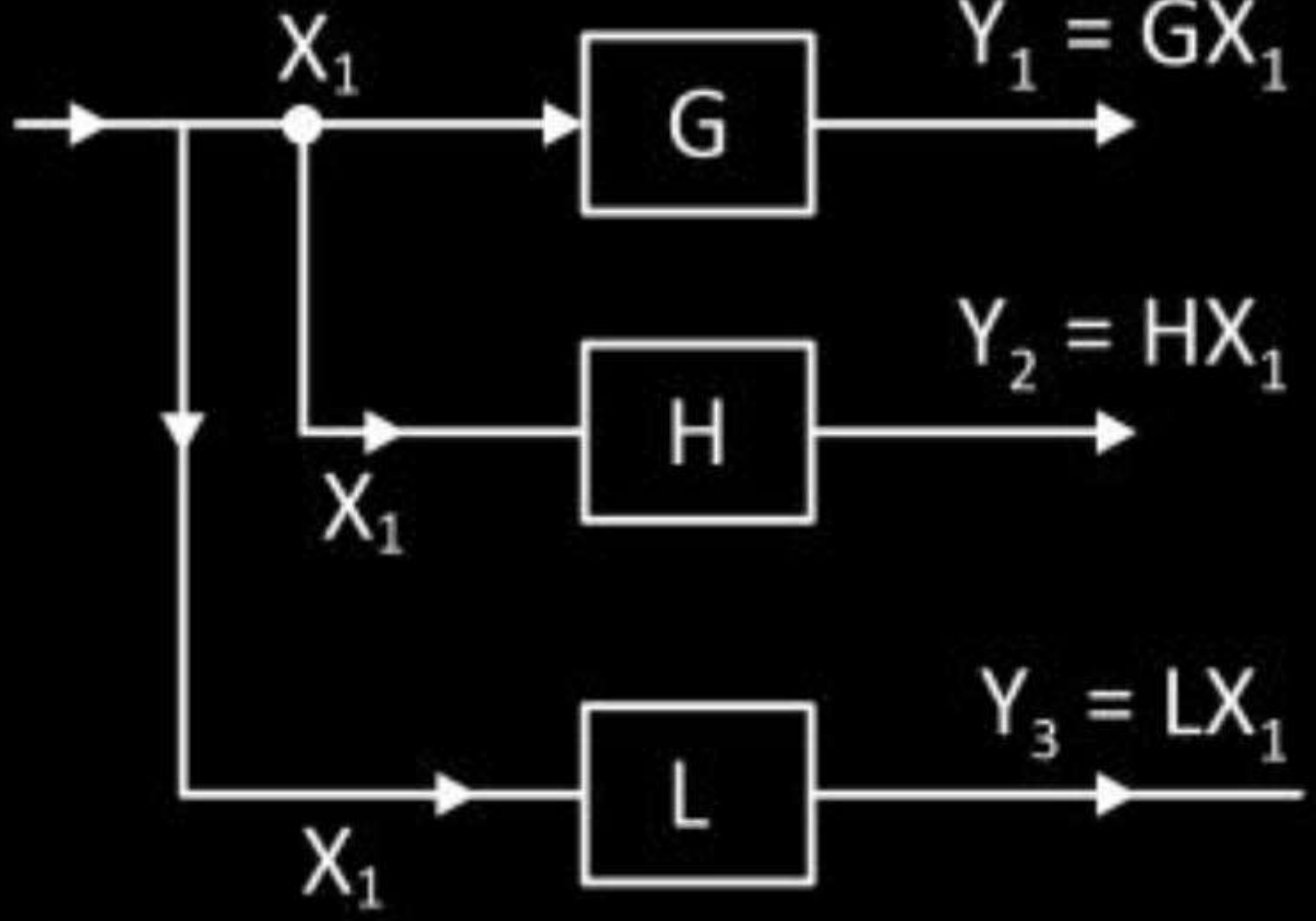


2. **Take off point :** single input and multioutput



1. TAKE-OFF POINT
2. Summer POINT
3. Summer POINT

Importance :



Note : Take off point is used for distribution of common input to different systems.

Table

Node	**Input**	**Output**
Summing	More than 1 or ≥ 2	Single / Multiple
Take off	1	Multiple

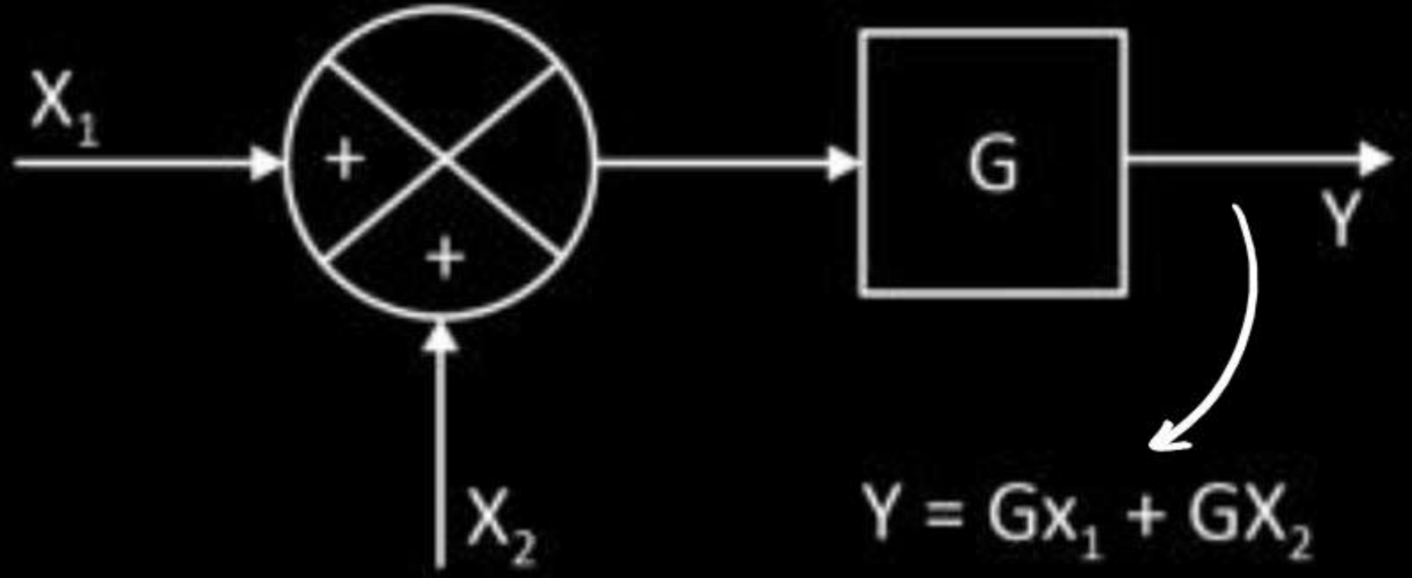
3. **Forward Gain :** Direction is always from input to output.

$$\boxed{G = \frac{Y}{X}}$$

Rules

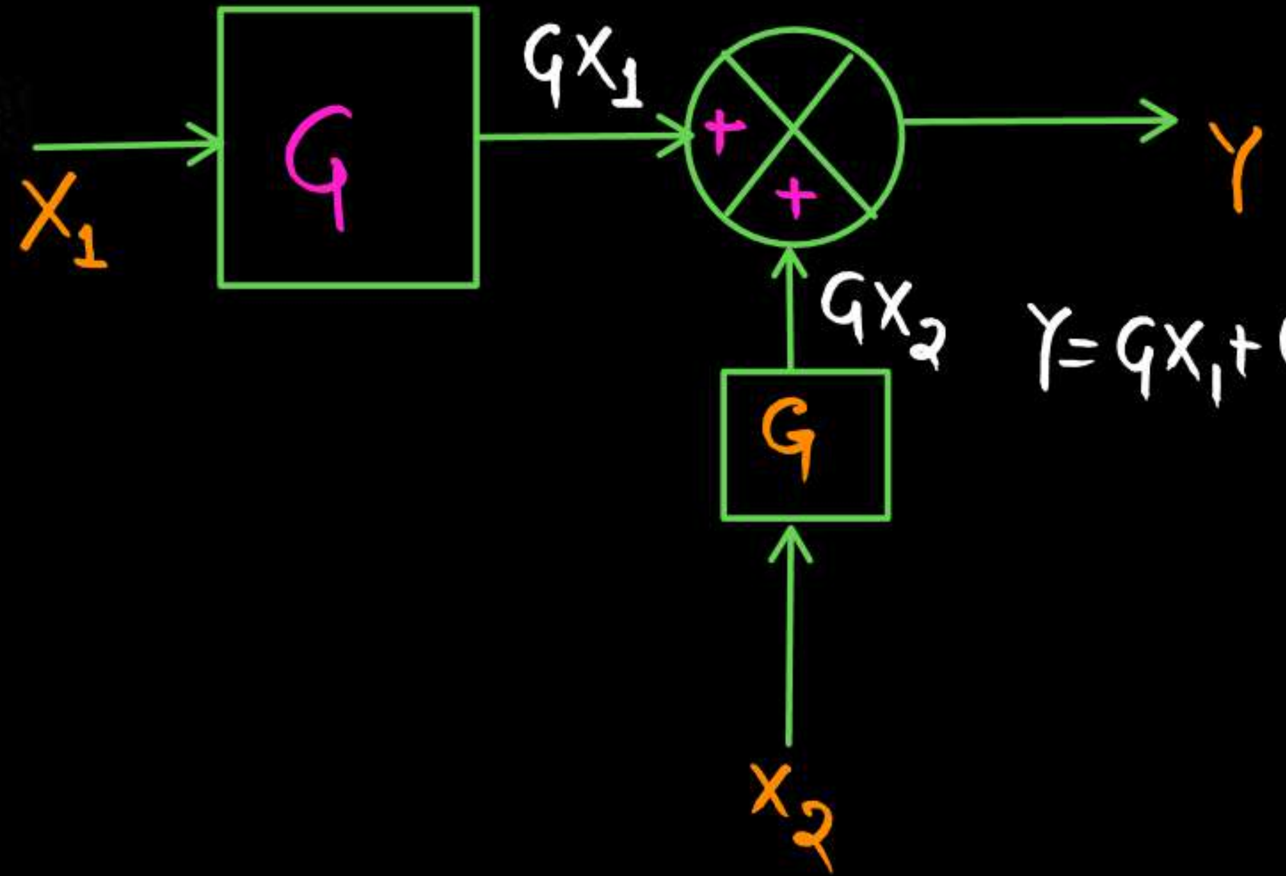
Case 1: Summer and Forward Gain

Case A:

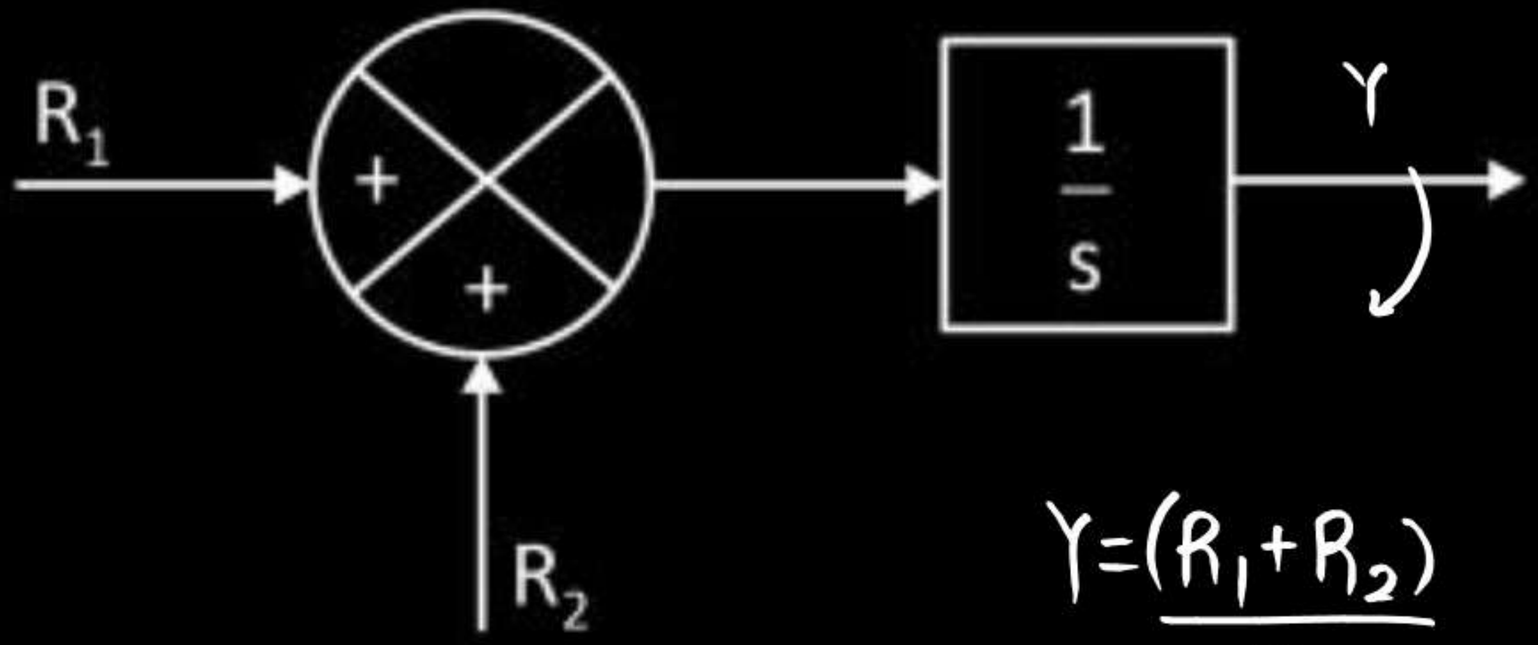


$Y = Gx_1 + GX_2$

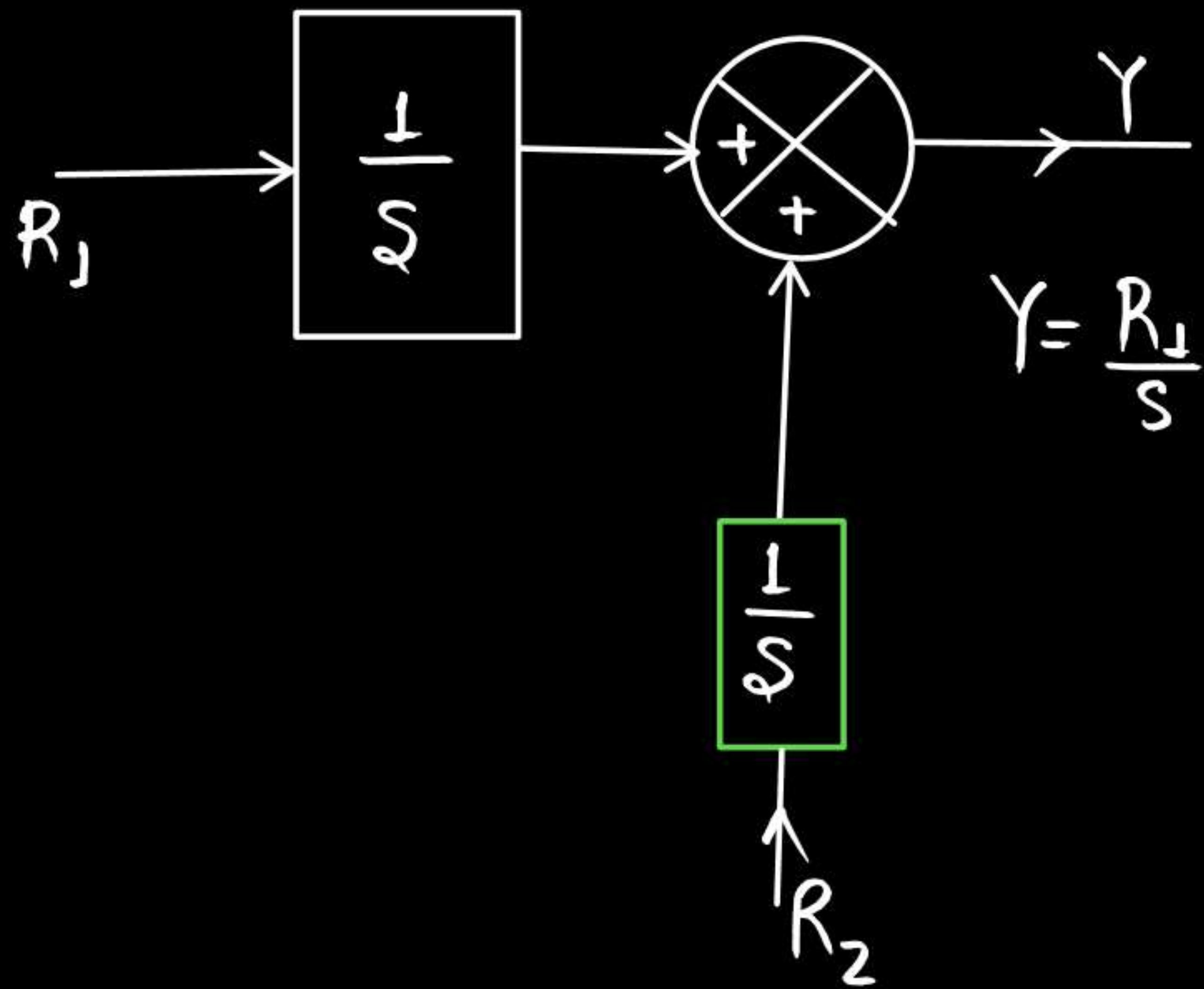
≡



$Y = GX_1 + GX_2$



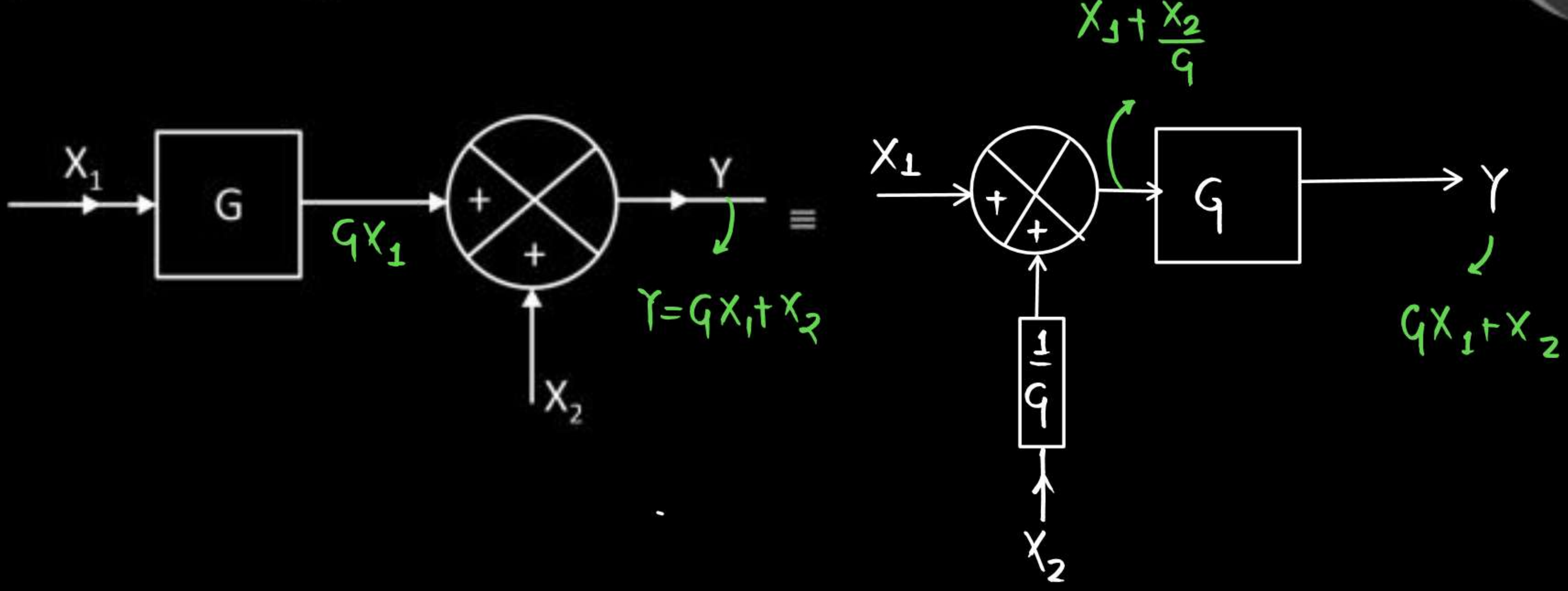
$\equiv$



$$Y = \frac{(R_1 + R_2)}{s}$$

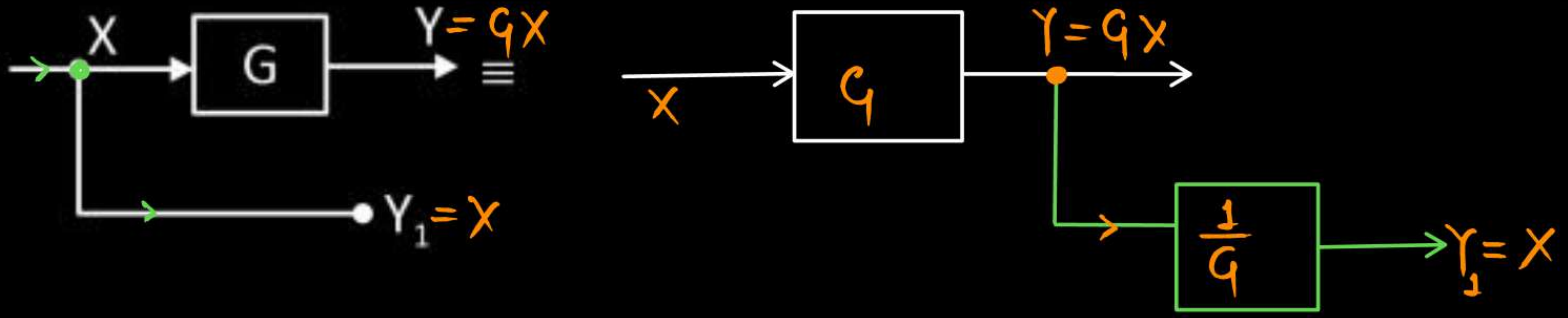
$$Y = \frac{R_1}{s} + \frac{R_2}{s}$$

(**Case B :**)

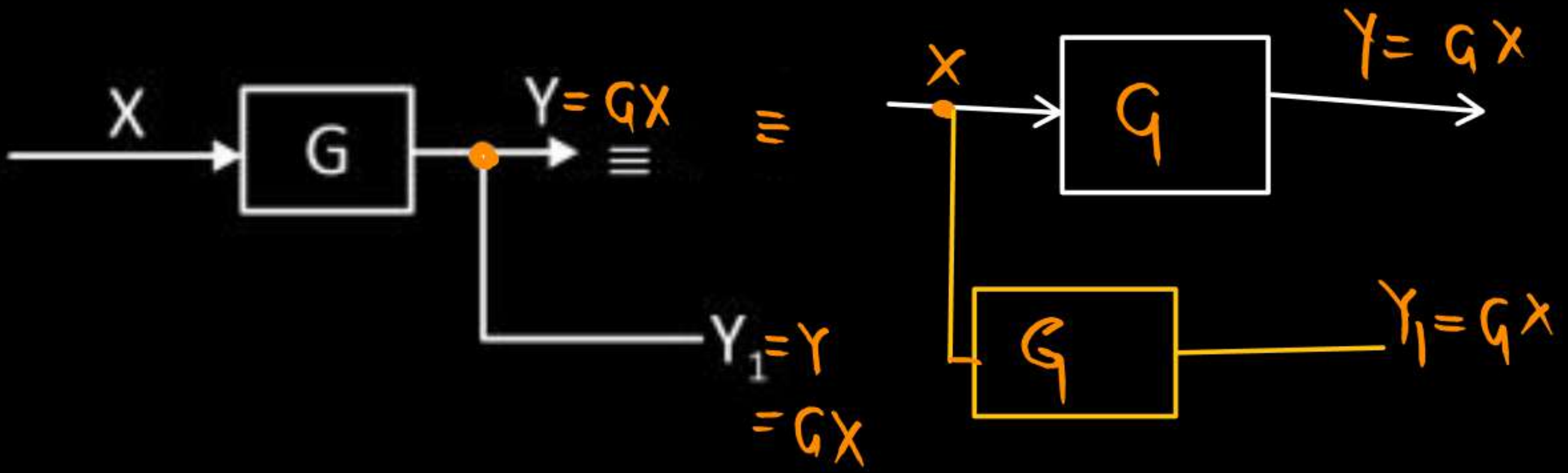


Case 2 : Take off point and Forward Gain

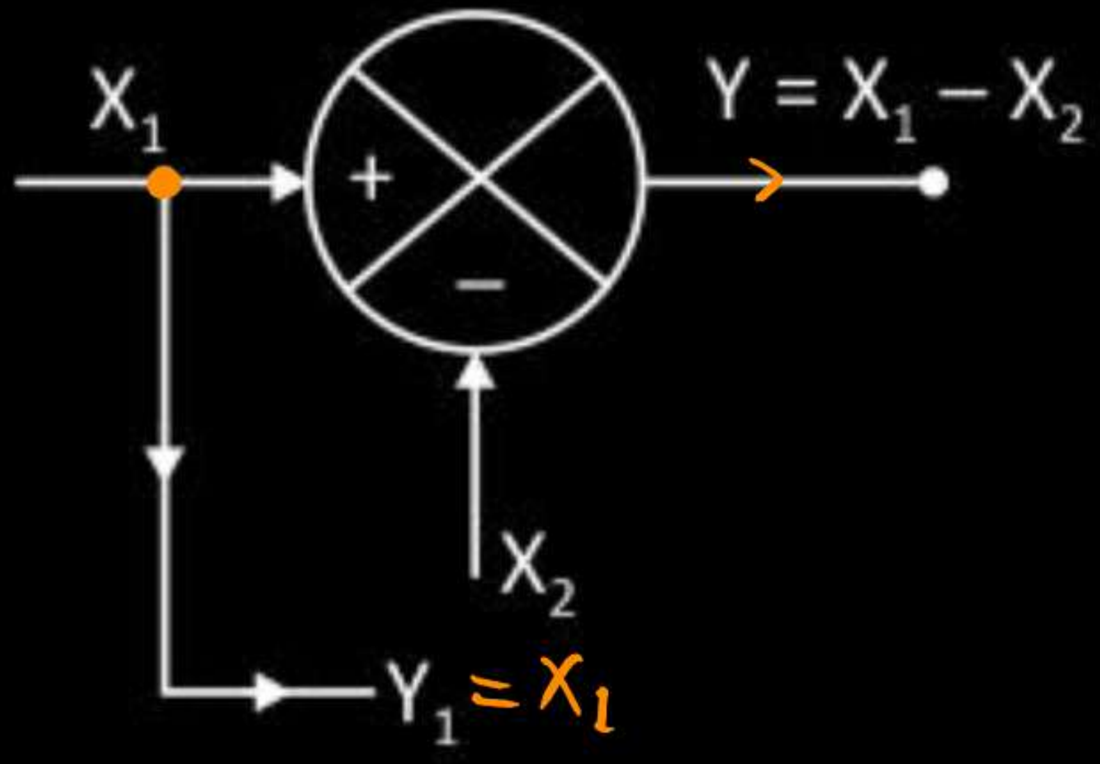
Case A:

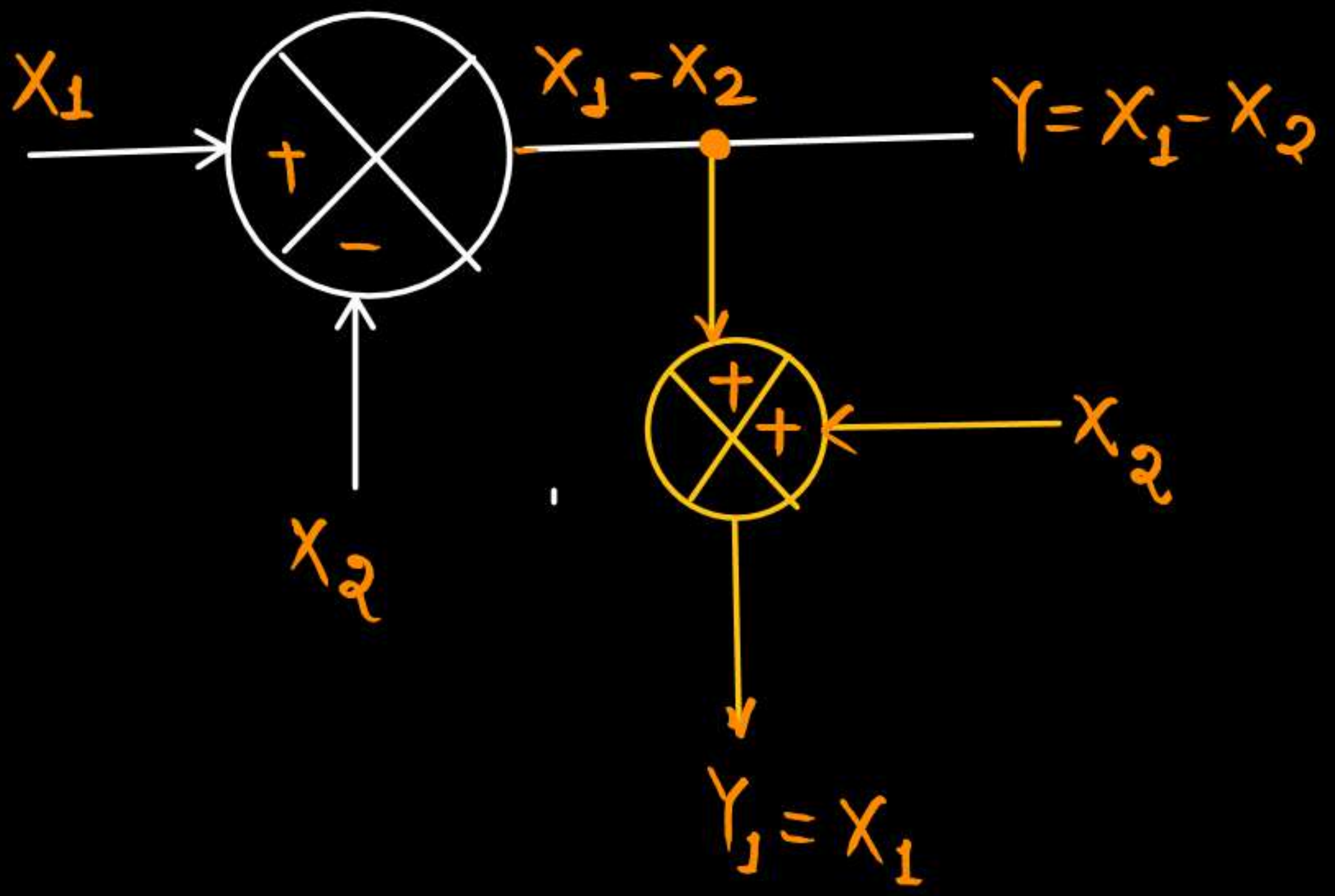


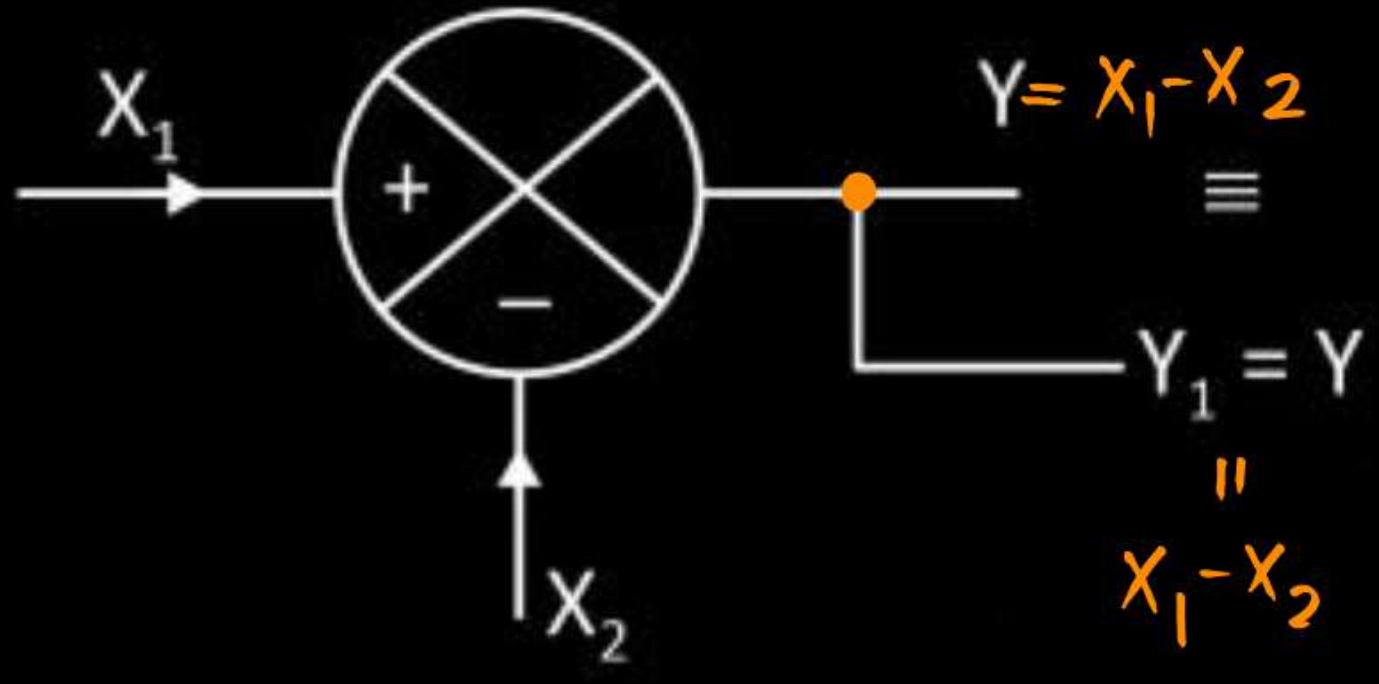
Case B:



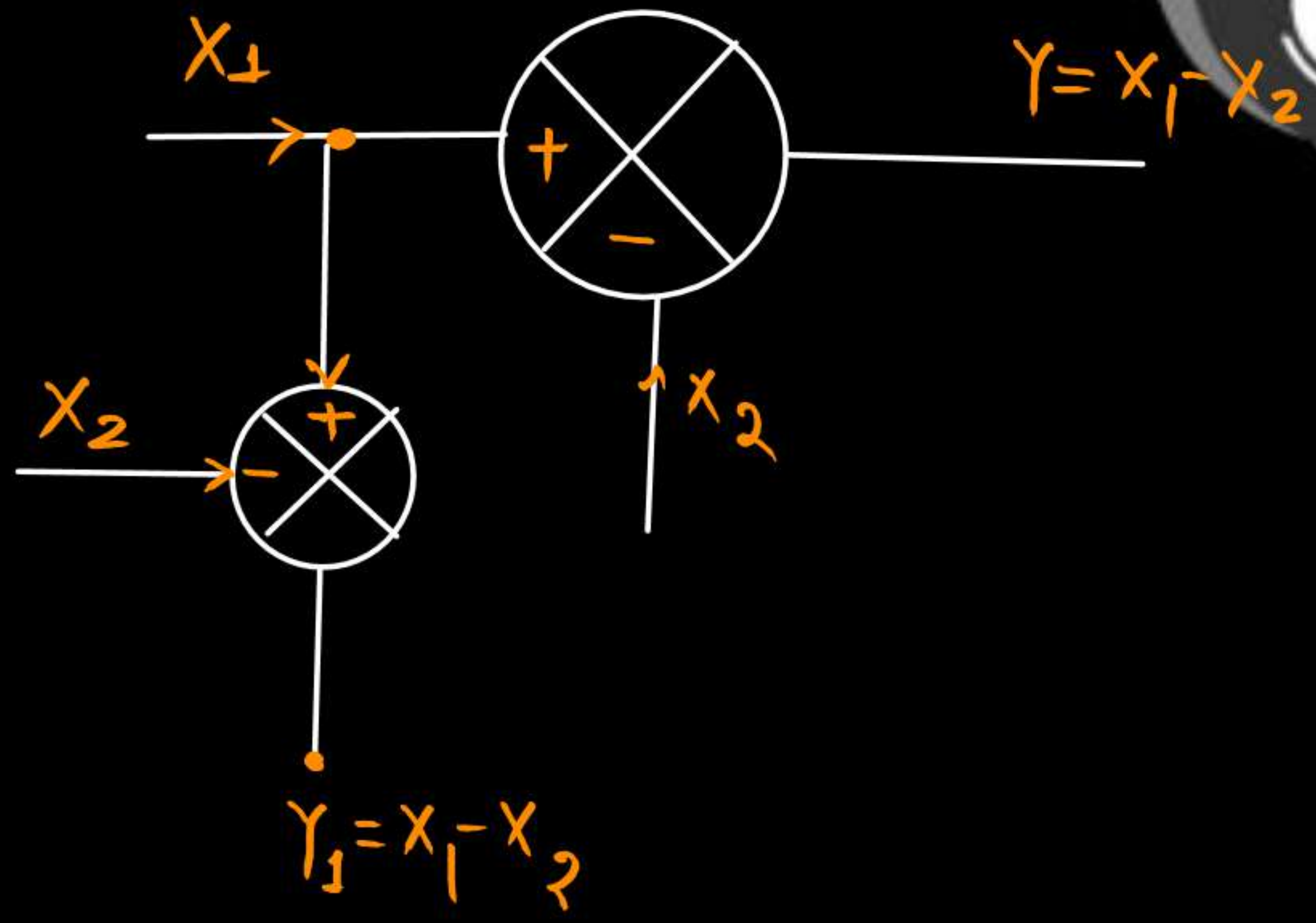
Case 3 : Take off point and Summer







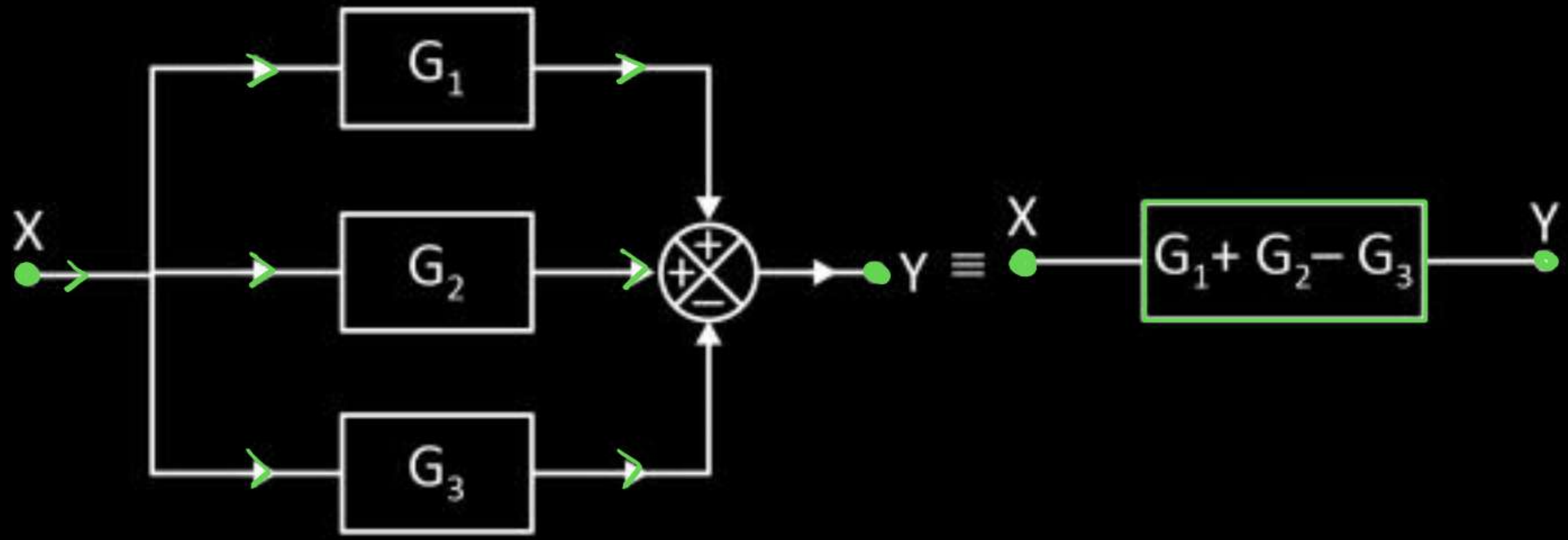
X_1
X_2
$Y = X_1 - X_2$
$\equiv$
$Y_1 = Y$
$= X_1 - X_2$

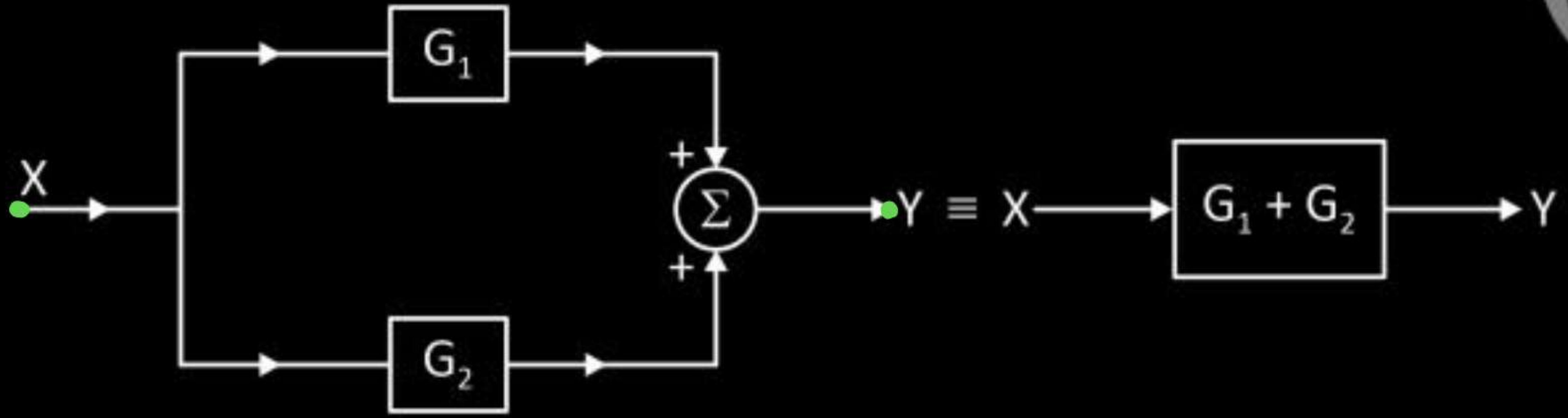


X_1
X_2
X_2
$Y = X_1 - X_2$
$Y_1 = X_1 - X_2$

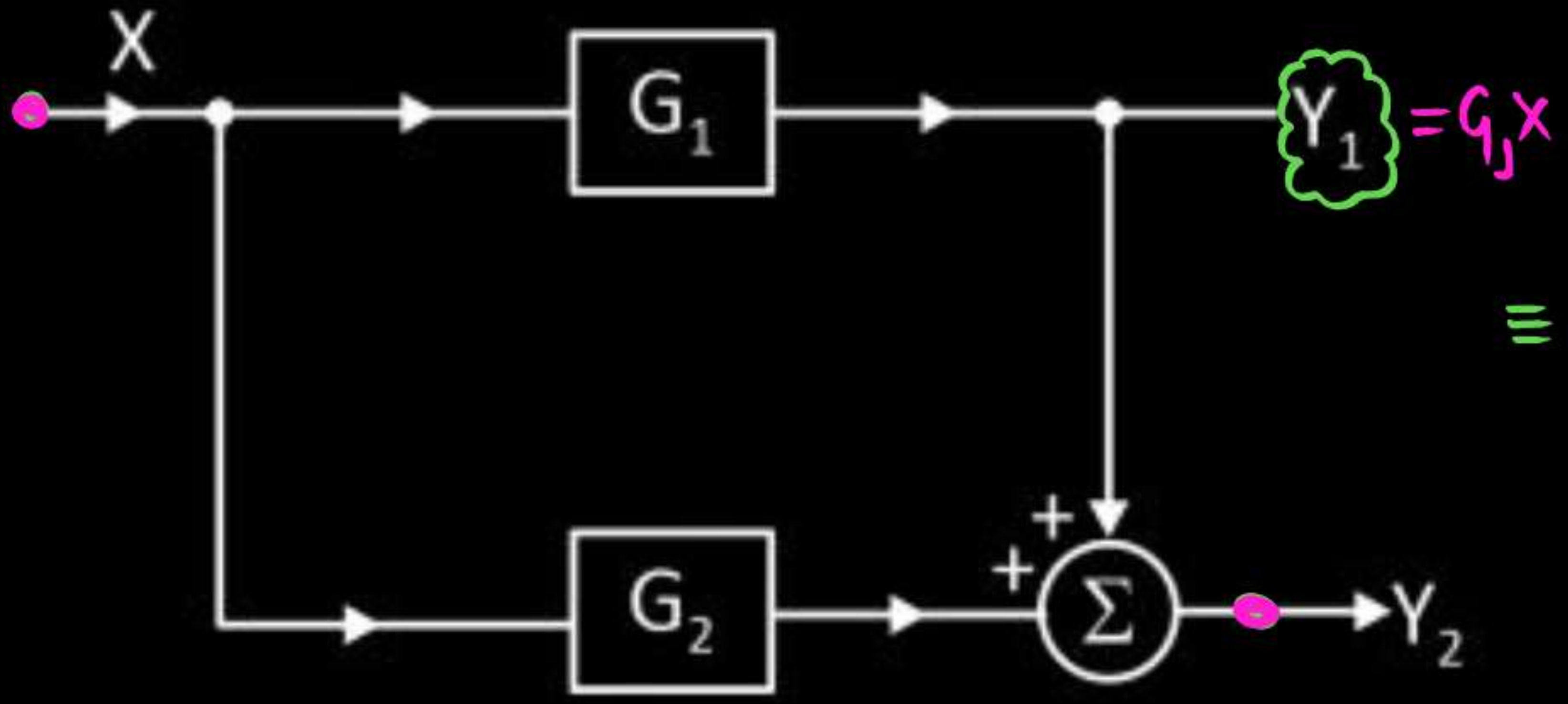
[Gain Connected in Parallel]

1. The direction of flow should be from input to output from all the gains.
2. Summing block should be common
3. Input should be common.

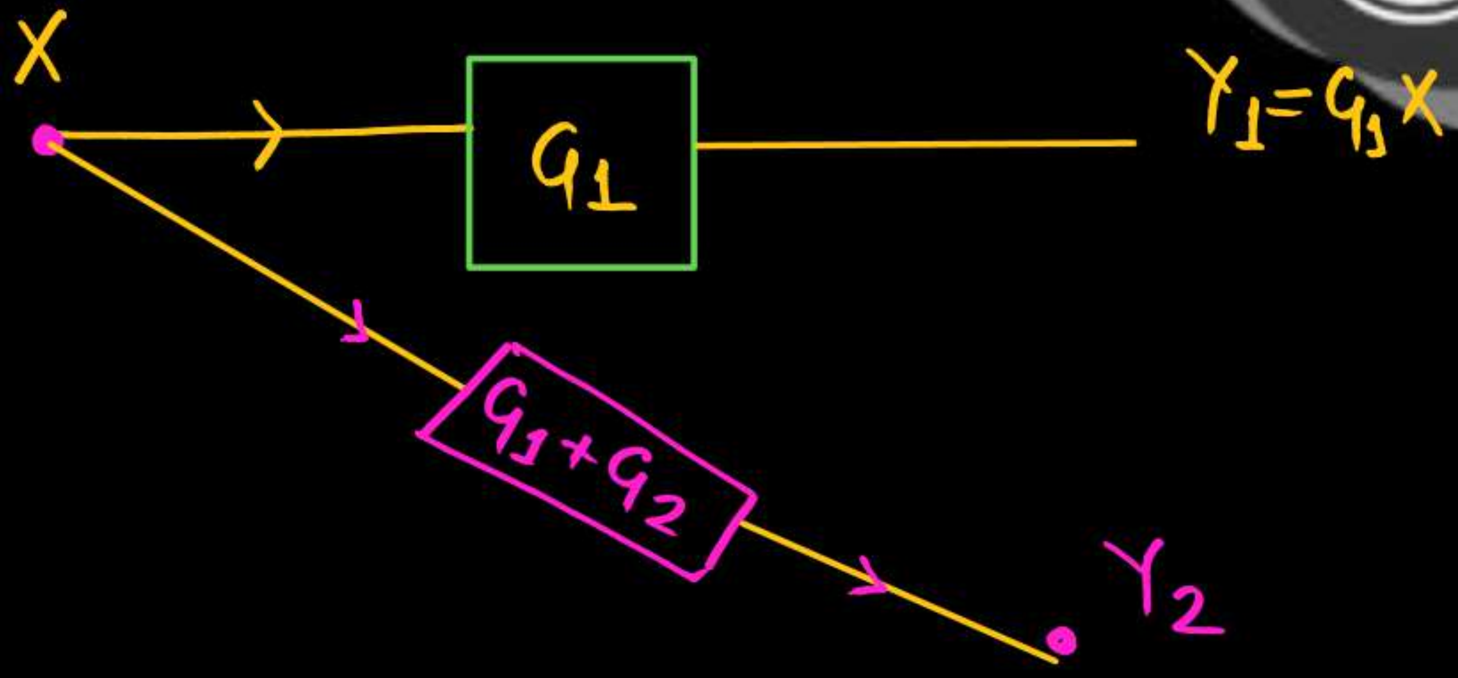



X
G1
G2
+
+
Σ
Y ≡ X
G1 + G2
Y

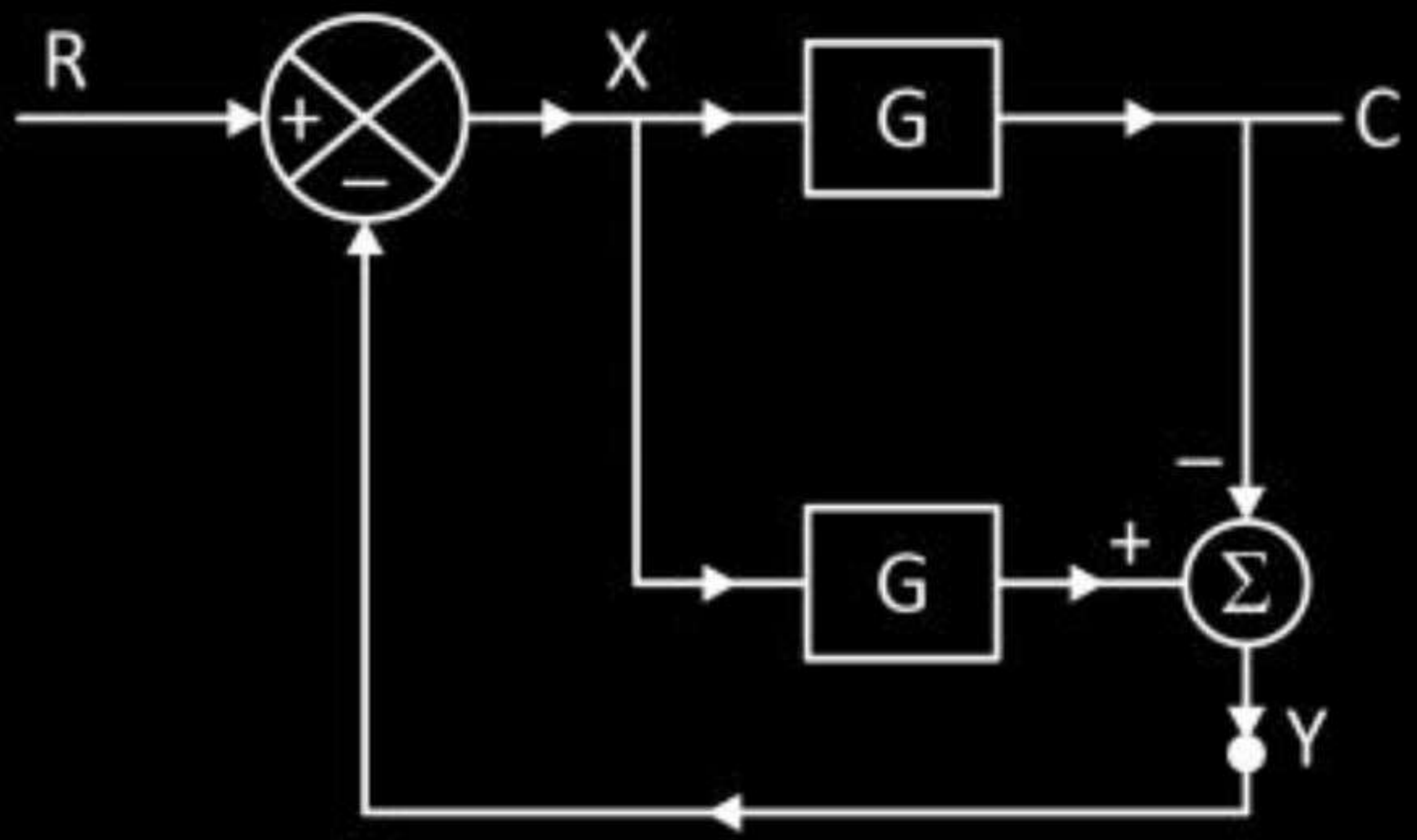
Question



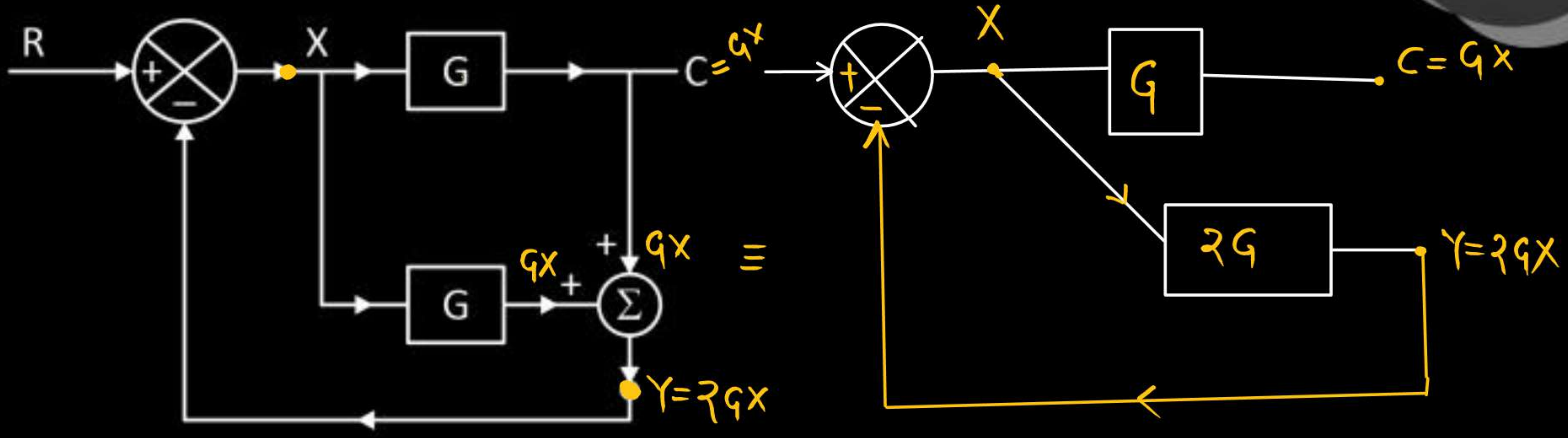
$\equiv$



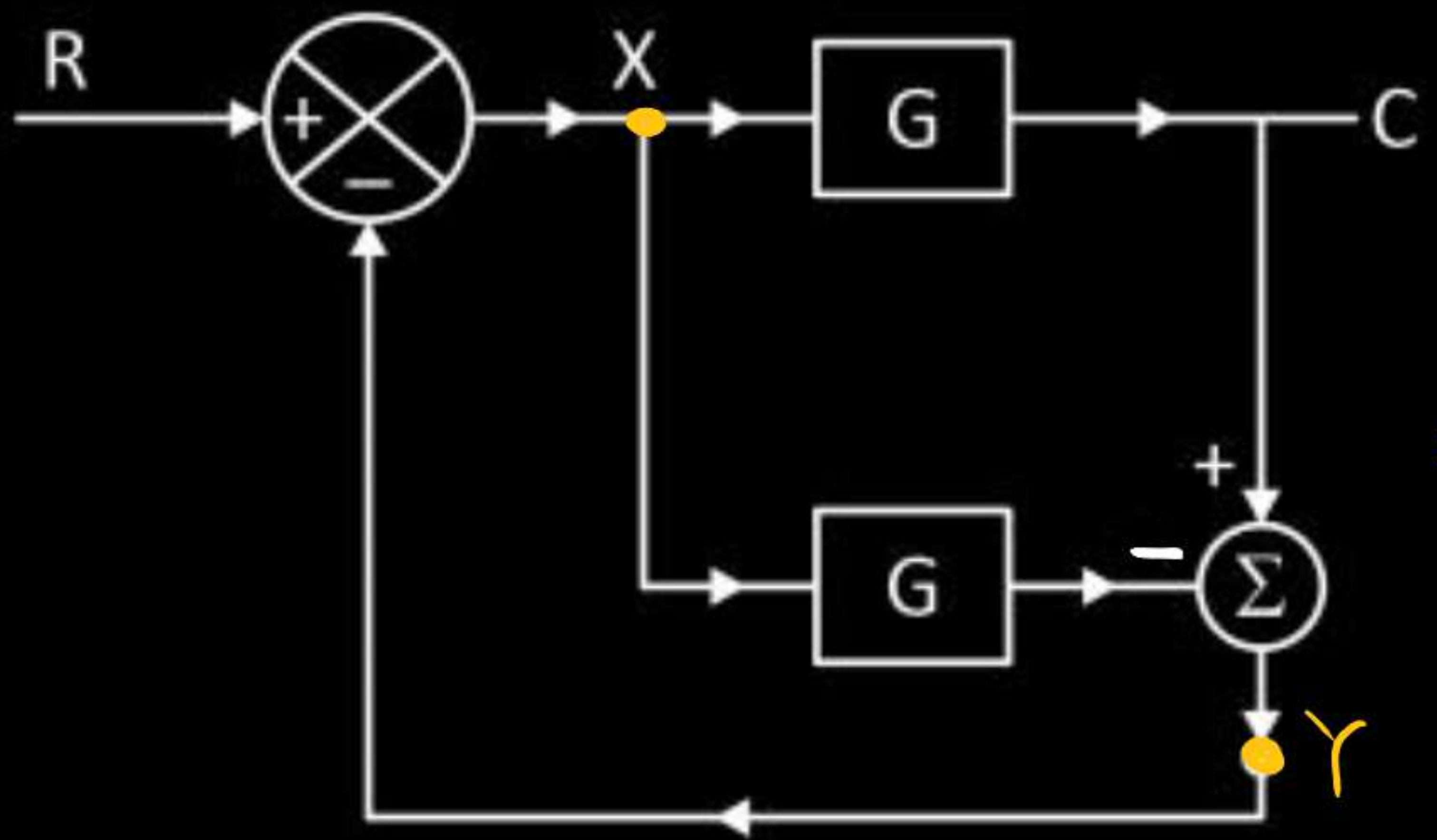
Question



Question



Question



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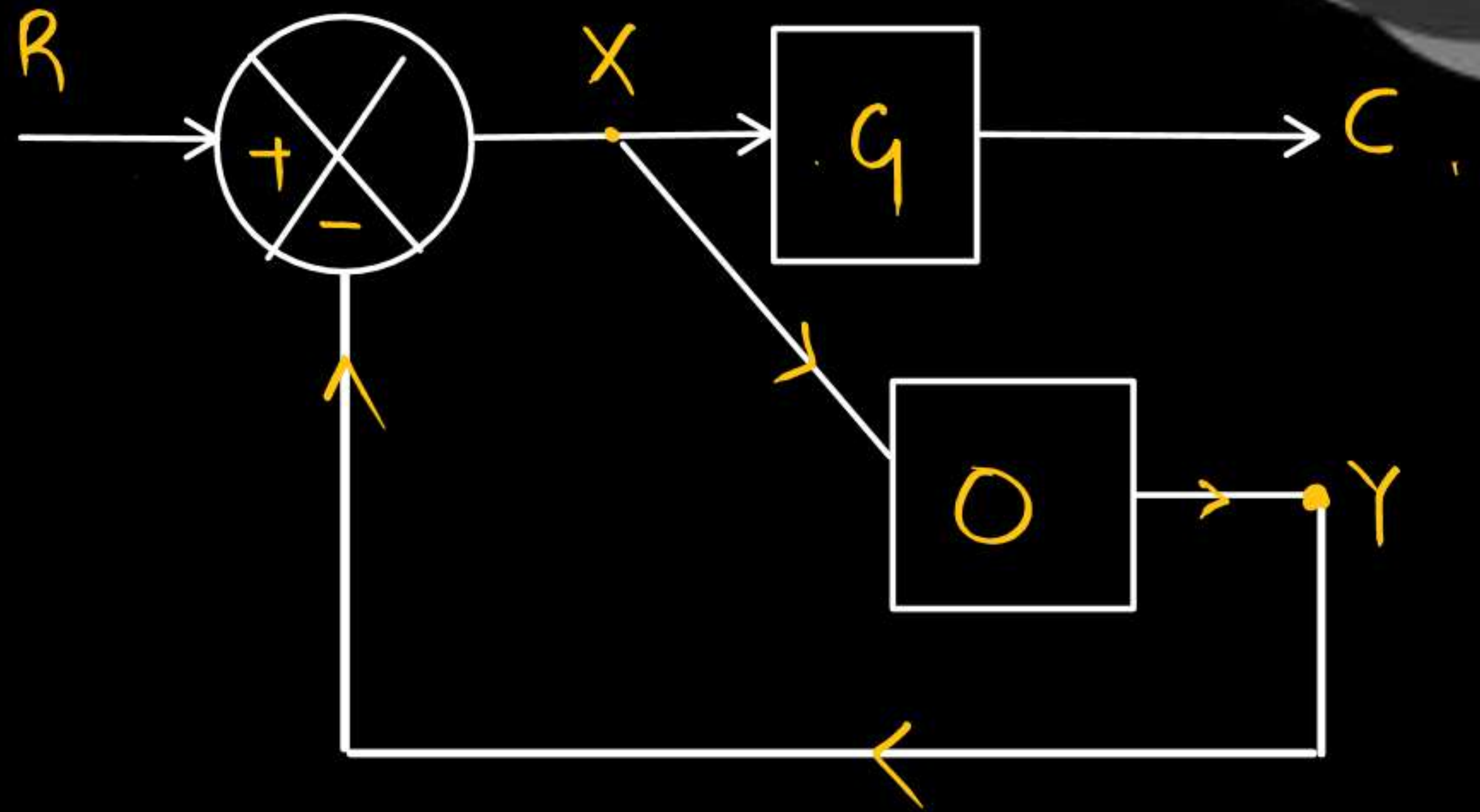
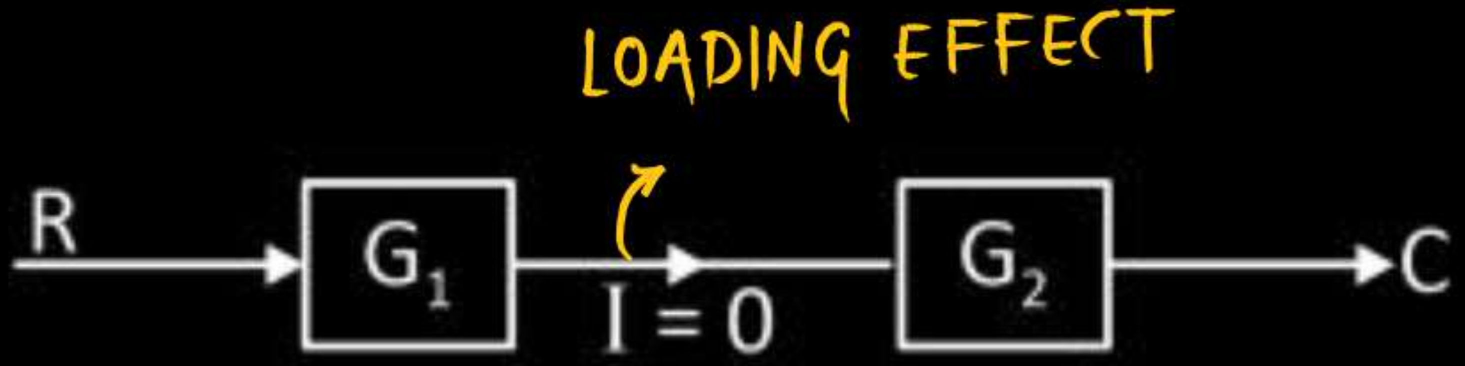
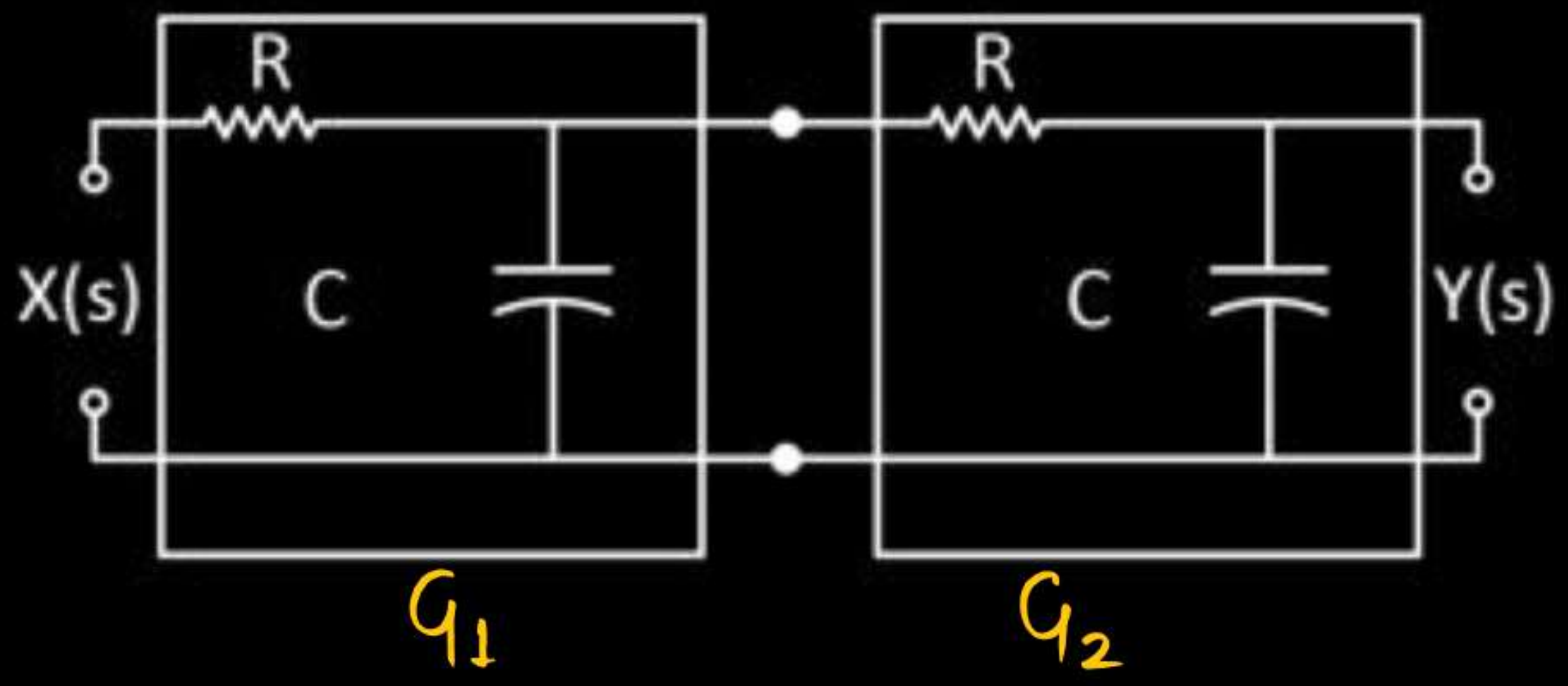
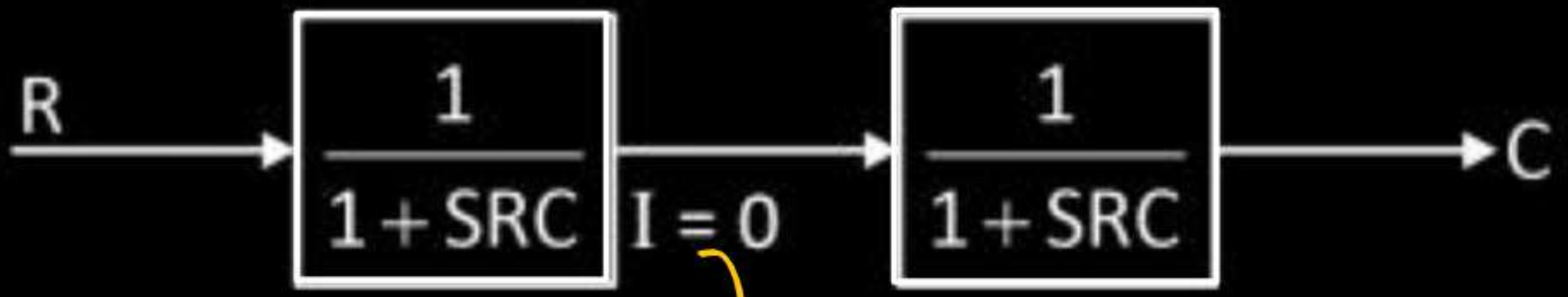


Gain Connected in Cascade



$$\boxed{\frac{C}{R} = G_1 G_2}$$



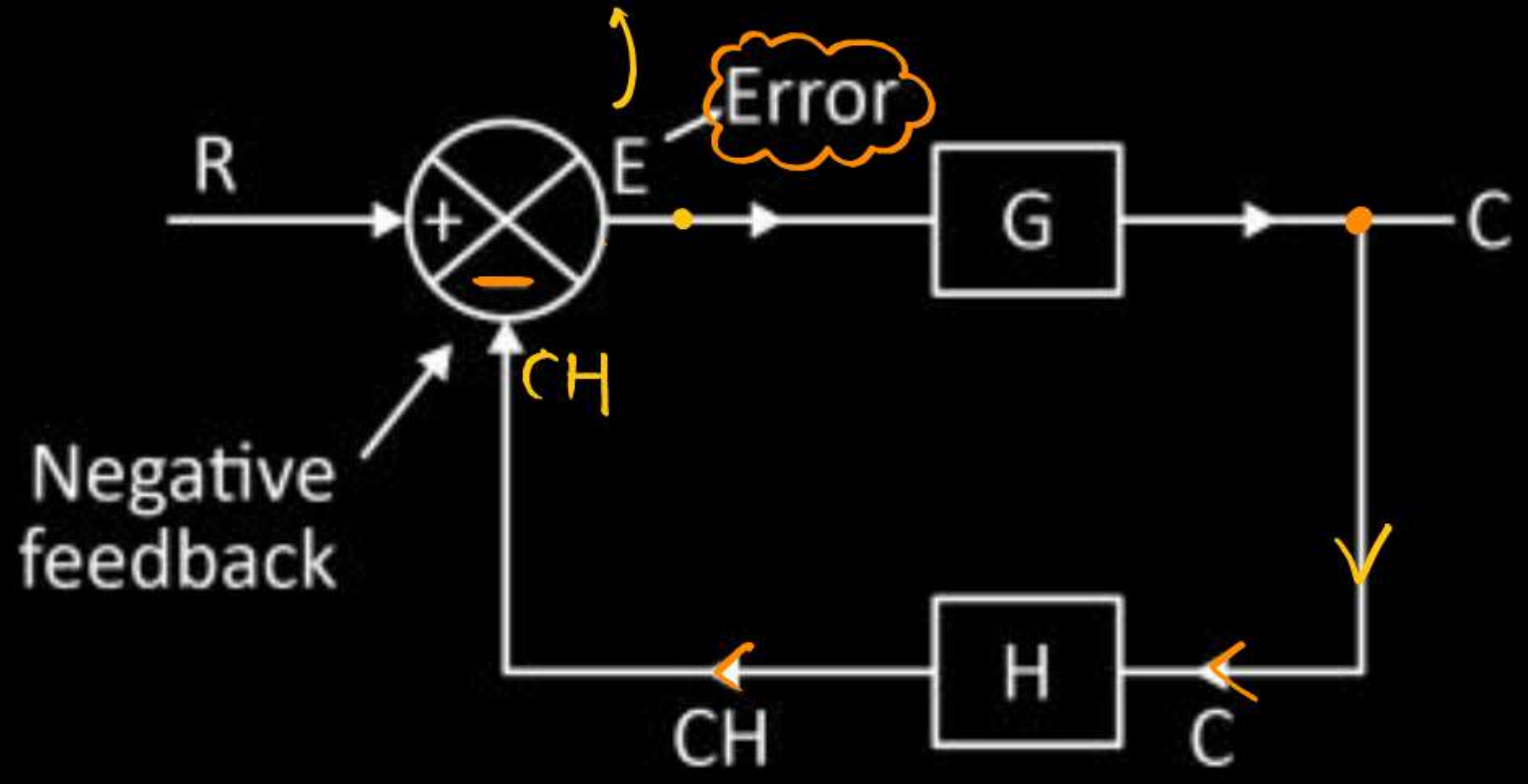


$$\frac{C}{R}=\left(\frac{1}{1+sRC}\right)^2, \text{Only when } \boxed{I = 0}$$

No loading effect.

[**Feedback**]

$E = R - CH$

1. 

$T = \frac{C}{R} = ?$

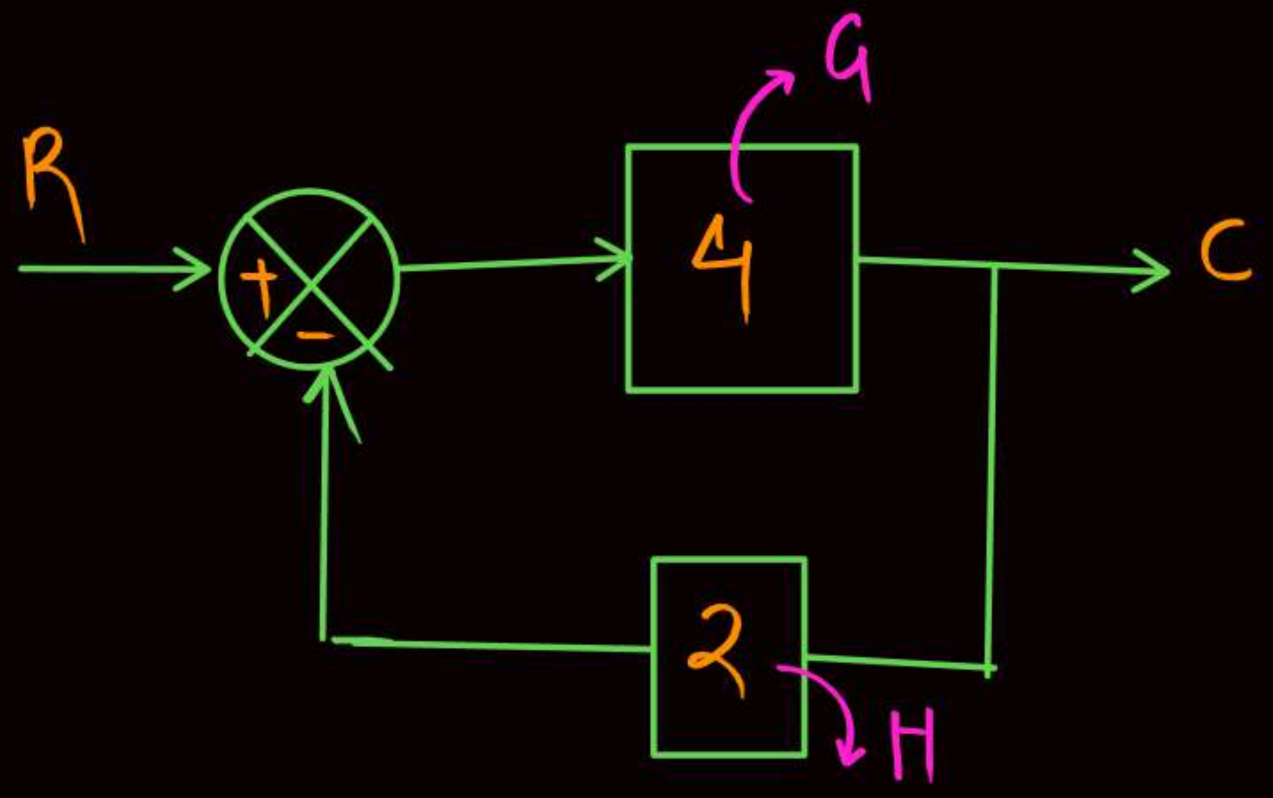
$C = EG$

$C = (R - CH)G$

$C = RG - CGH$

$C(1 + GH) = RG$

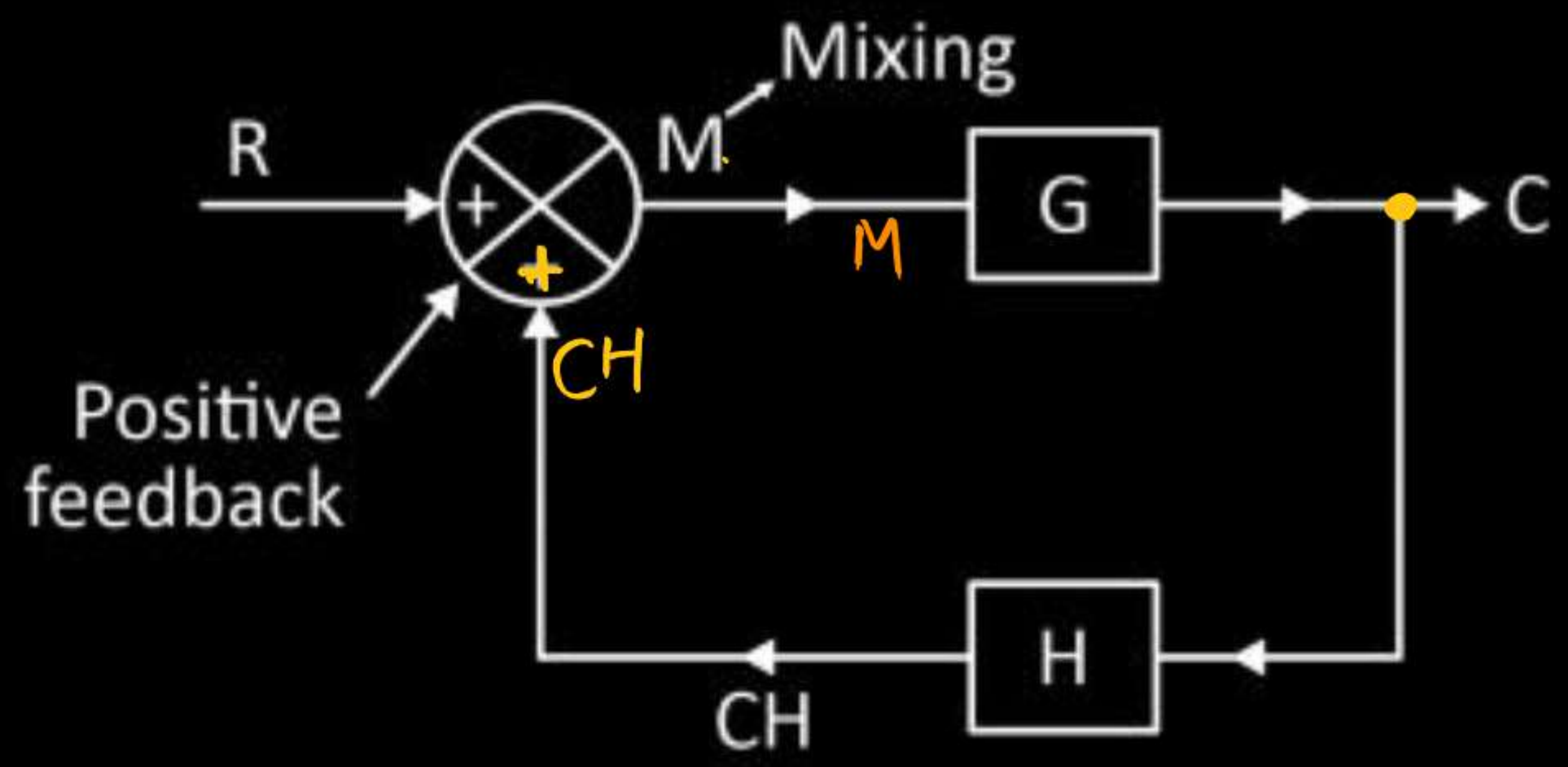
$$\boxed{\frac{C}{R} = \frac{G}{1 + GH}}$$



$$T = \frac{C}{R} = \frac{G}{1+GH} = \frac{4}{1+8}$$

$$= \frac{4}{9}$$

2.



$$T = \frac{C}{R} = ?$$

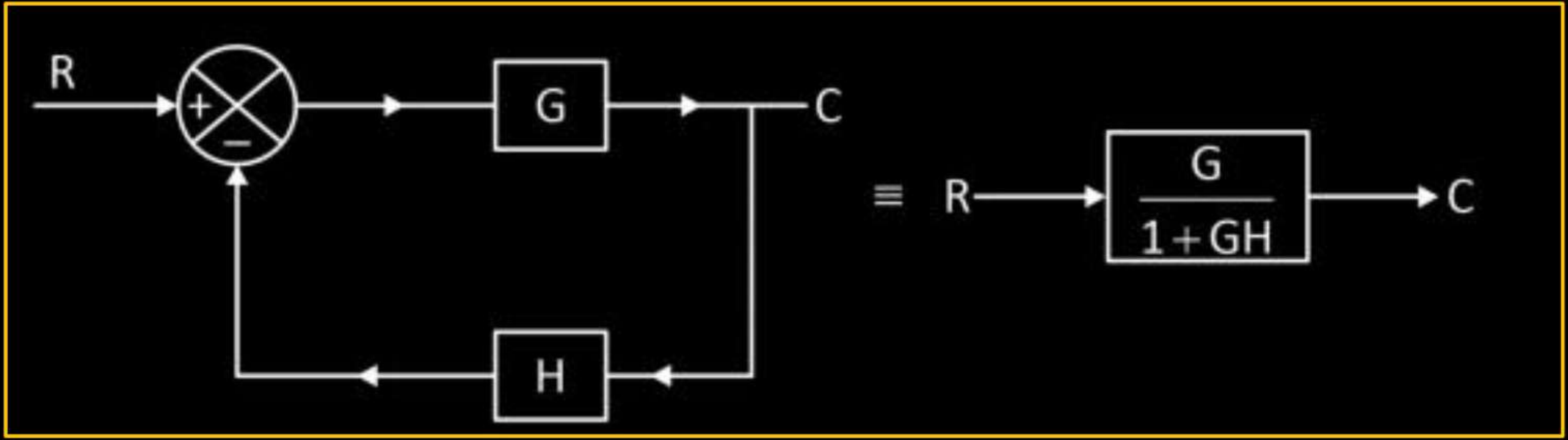
$$C = MG$$

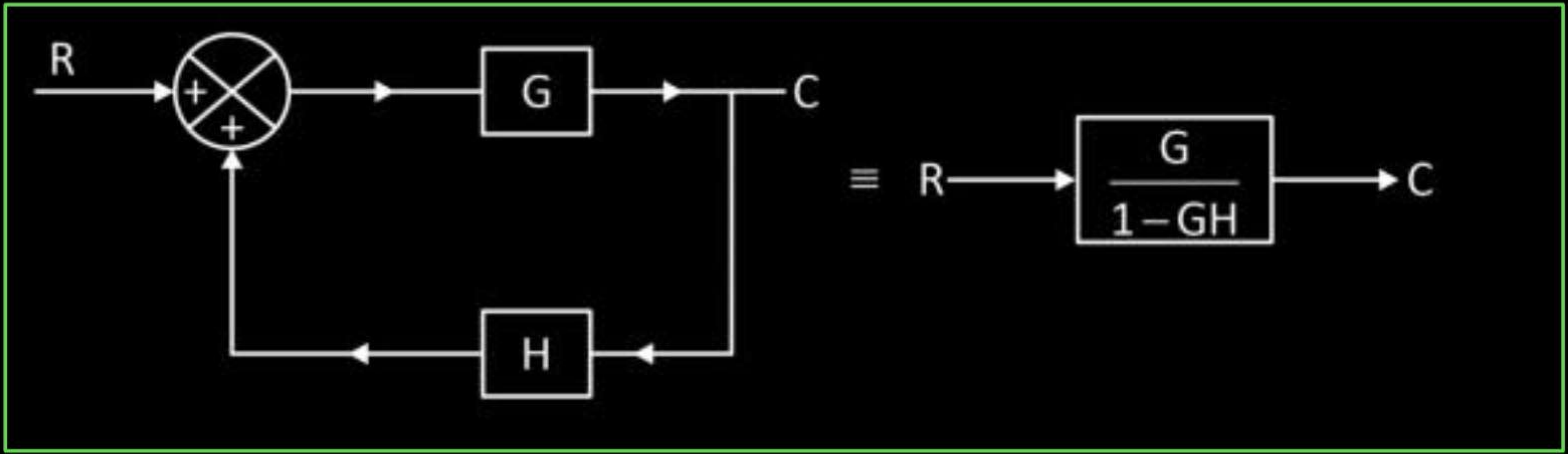
$$C = G(R + CH)$$

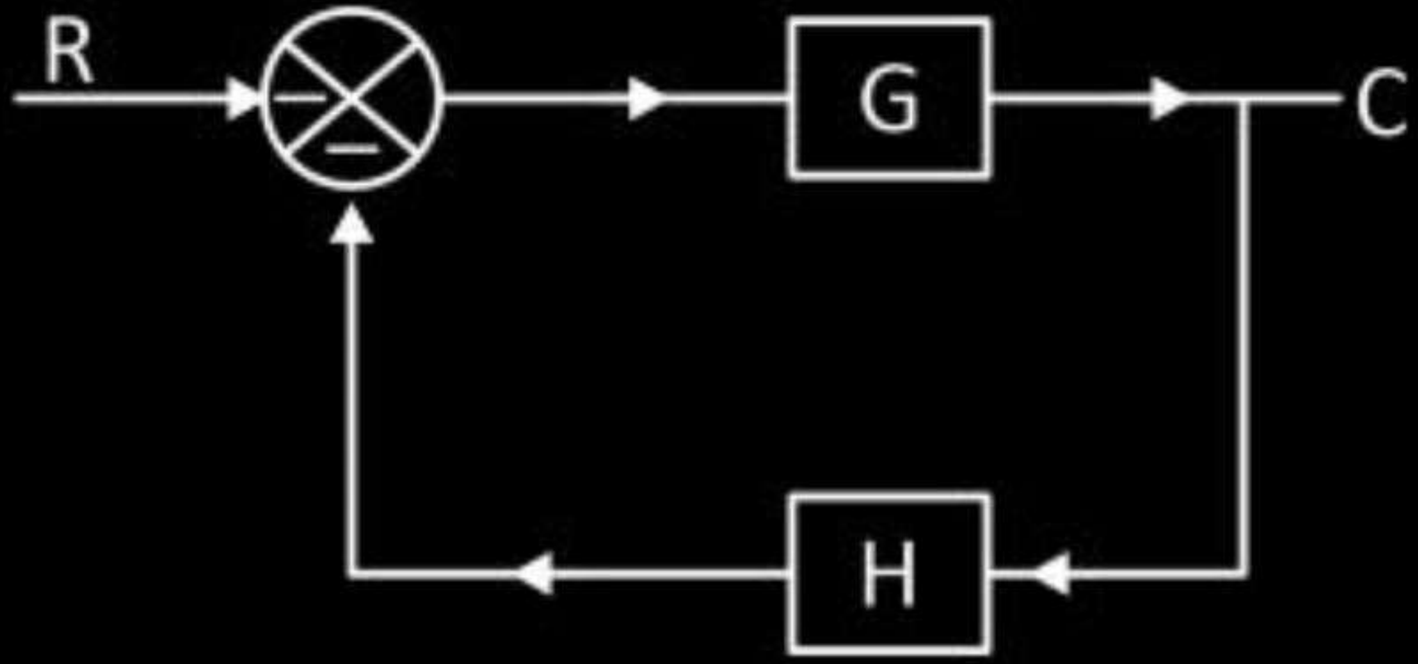
$$C = RG + GCH$$

$$C(1 - GH) = RG$$

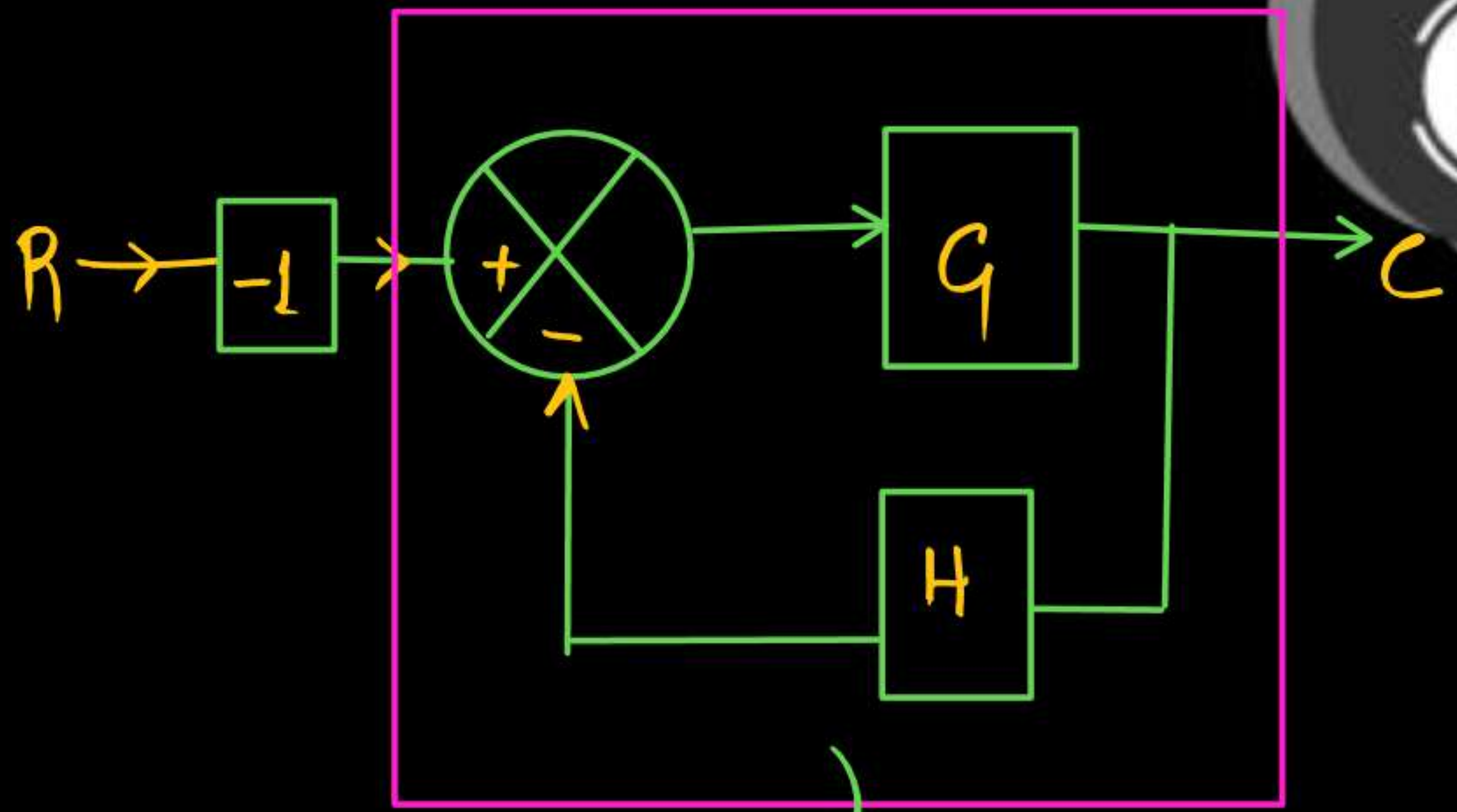
$$\boxed{\frac{C}{R} = \frac{G}{1 - GH}}$$


R
+
−
G
C
H
≡ R
$\frac{G}{1+GH}$
C

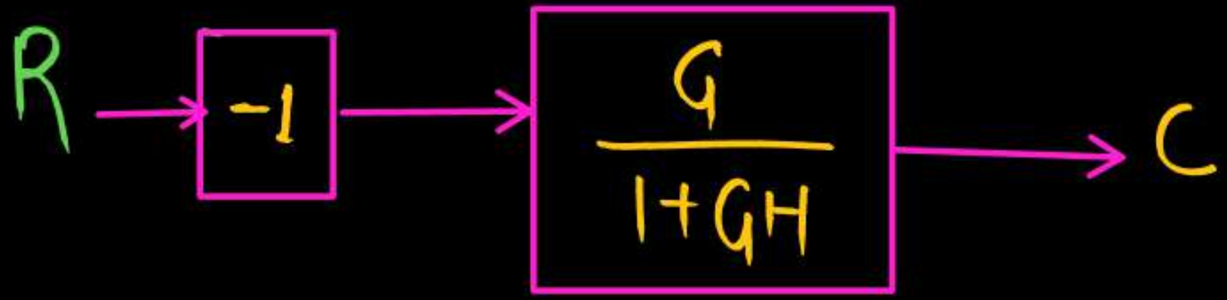

R
+
+
G
C
H
≡ R
$\frac{G}{1-GH}$
C



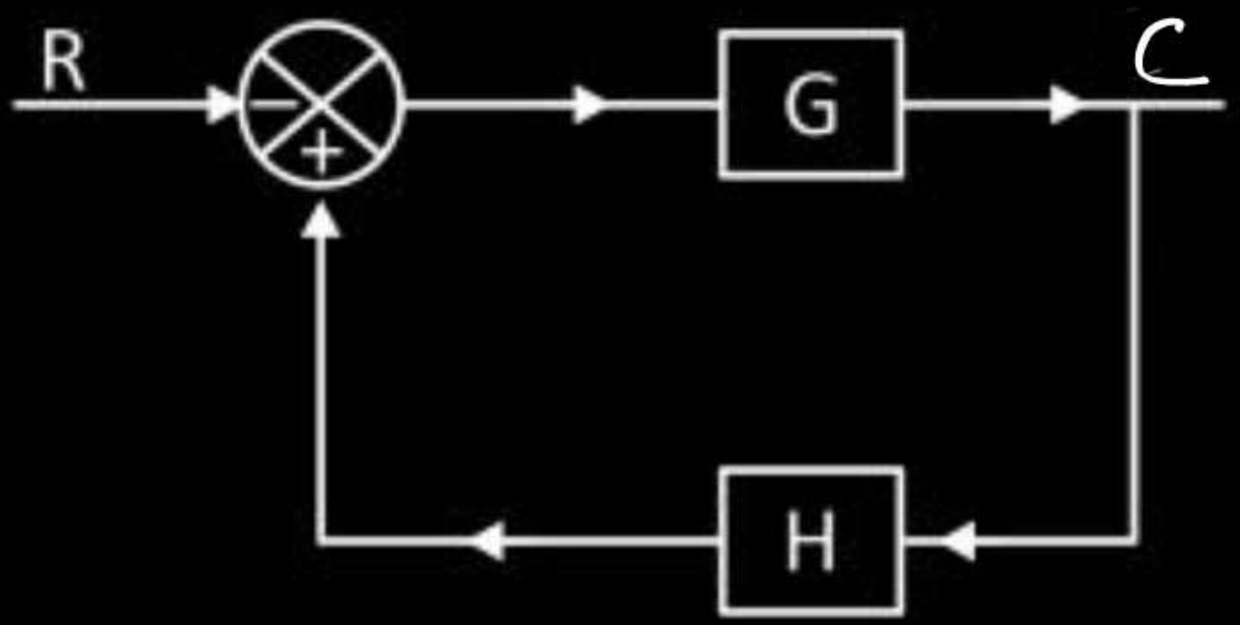
$\equiv$



$$\frac{G}{1+GH}$$



$$\boxed{\frac{C}{R} = \frac{-G}{1+GH}}$$



$\equiv$

$$\boxed{\frac{C}{R} = \frac{-G}{1-GH}}$$

Thank you

GW Soldiers !