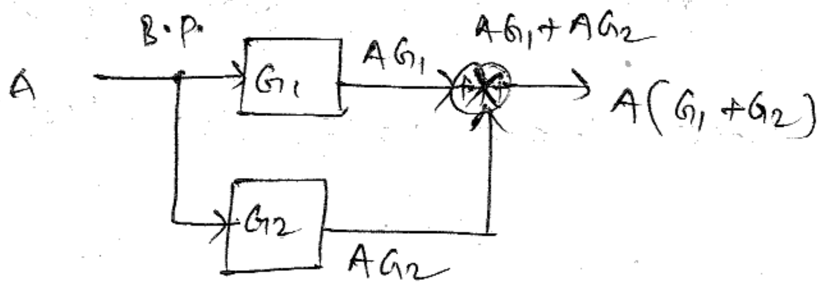
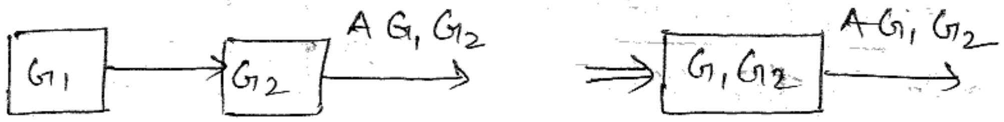
Blocks in parallel. (feed forward path)

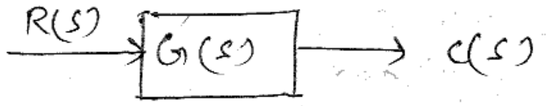


J.S.
02/07/11

Block Diagram reduction rules:

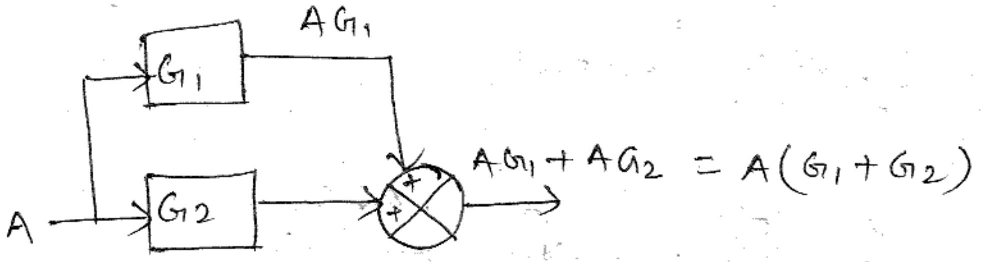
1 ⇒ Combining of block in cascade:

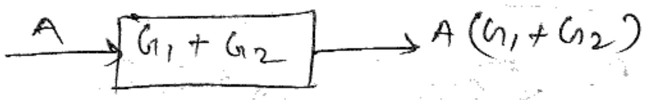




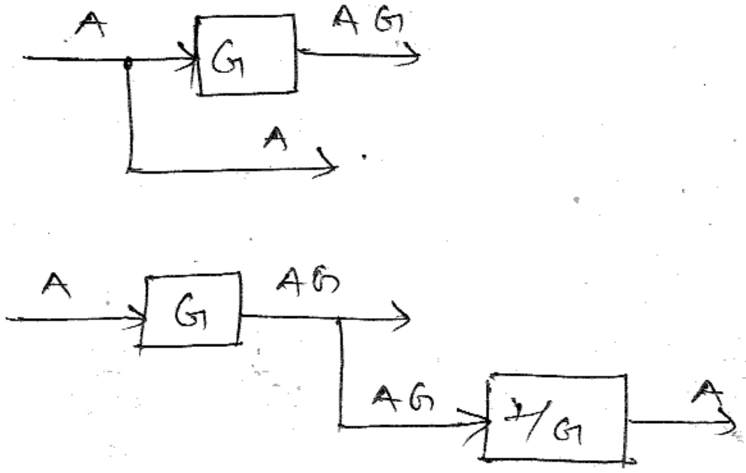
$$\frac{C(s)}{R(s)} = G(s)$$

2 ⇒ Combining block in parallel (combining feed forward paths)

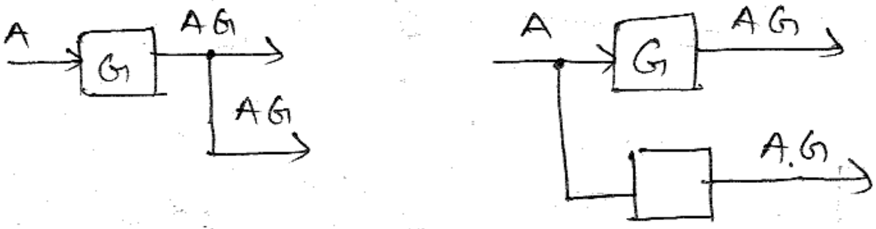




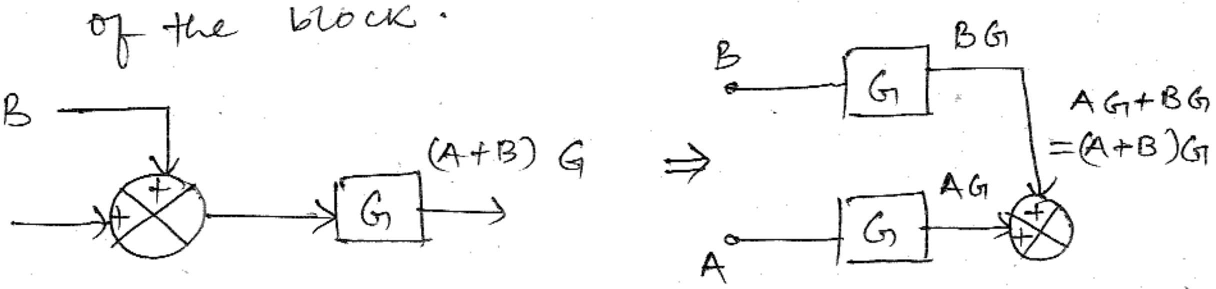
3 ⇛ Moving the branch point ahead of the block.



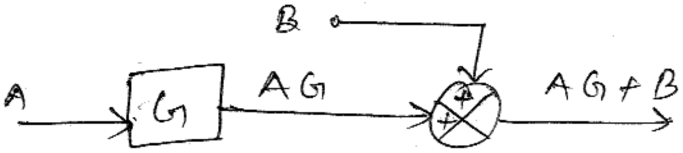
4] Moving the branch point before the block.

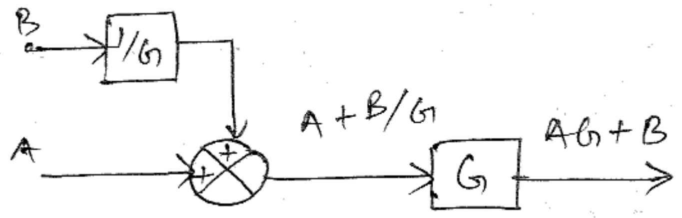


5] Moving the summing point ahead of the block.

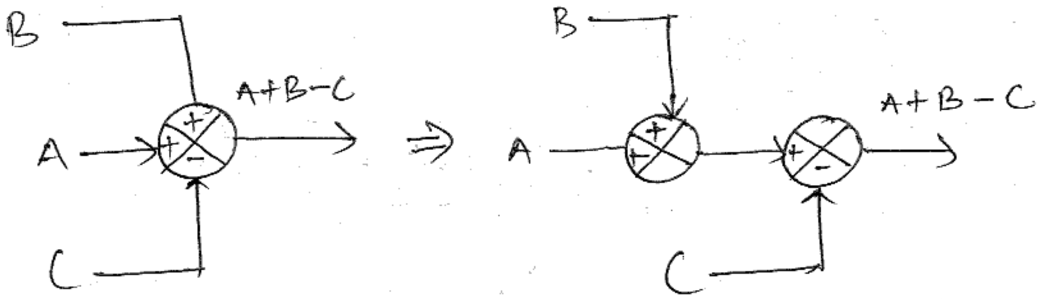


6] Moving the summing point before of the block.

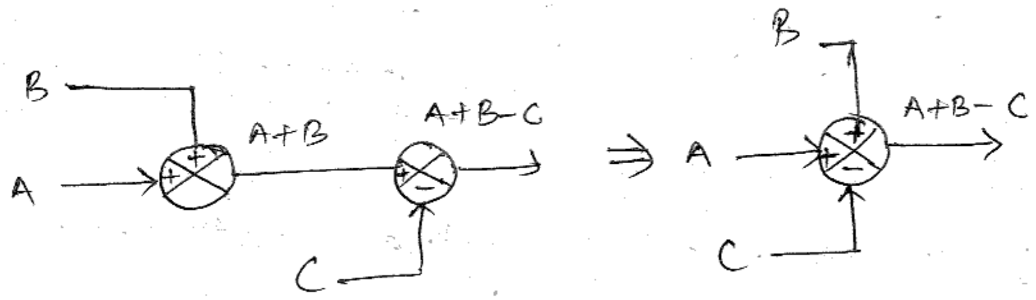




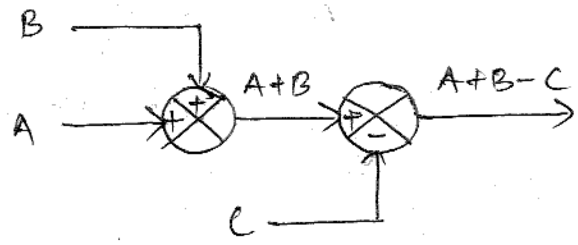
7] Splitting of summing point.

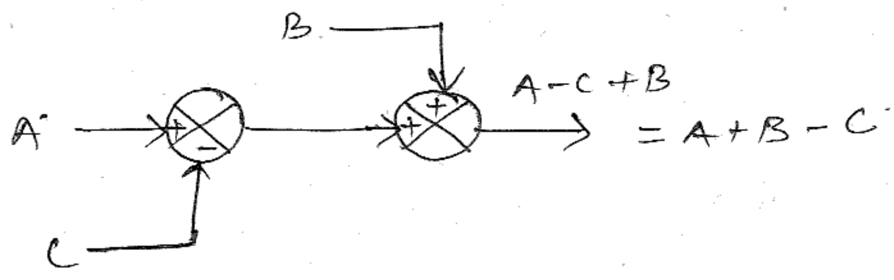


8] Combining summing points :

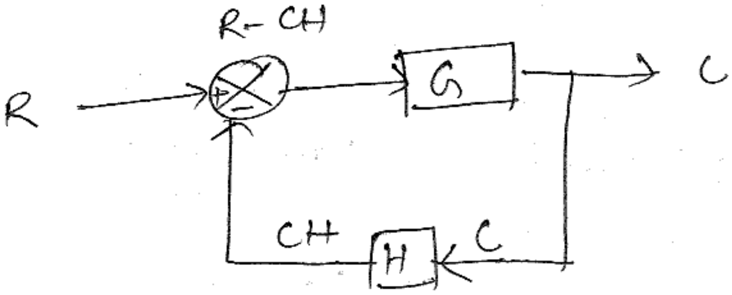


(9) Interchanging summing points.





10] <u>Elimination of feedback loop</u>



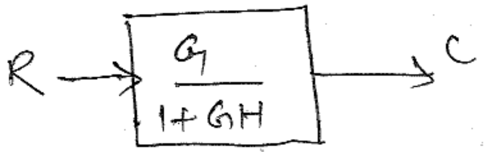
$$C = (R - CH)\,G$$

$$C = RG - CGH$$

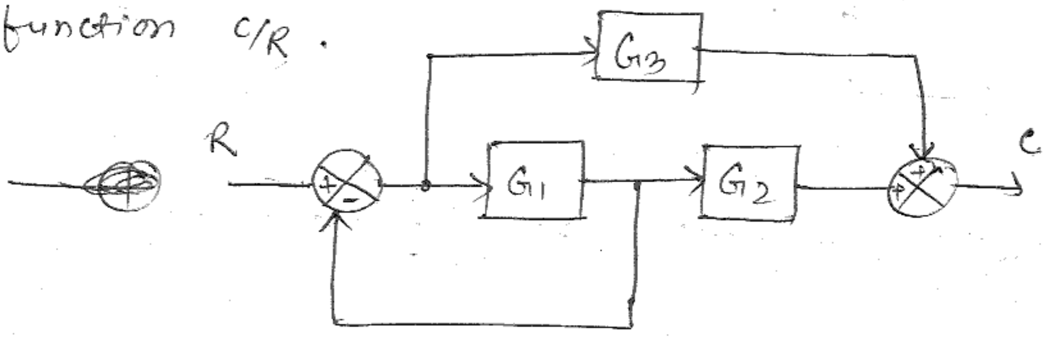
$$C + CGH = RG$$

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

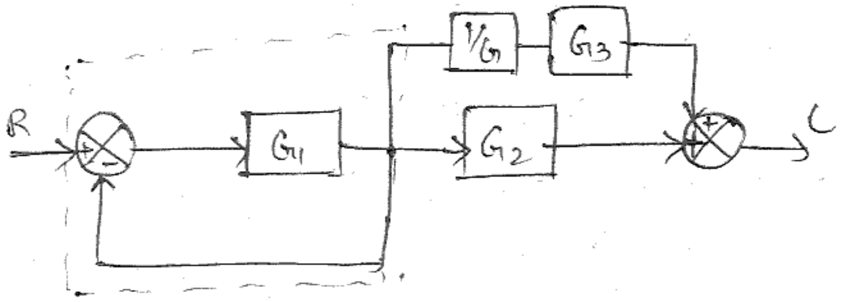
$$\boxed{\frac{C}{R} = \frac{G}{1+GH}}$$



06/07/11. Reduce the block diagram shown in figure and hence find the transfer function C/R.



Step-1: Move the branch point after the block G_1.



Step-2: Eliminate the feedback loop and combine blocks in cascade.

08/07/2011

Mason's Gain formula to determine the transfer function of the system from the signal flow graph.

Let $R(s)$ = Input to the system

and $C(s)$ = output of the system

Transfer function of the system,

$$T(s) = \frac{C(s)}{R(s)}$$

Mason's gain formula states that the overall gain or the transfer function is given by,

$$T = \frac{1}{\Delta} \sum_K P_K \Delta_K$$

where

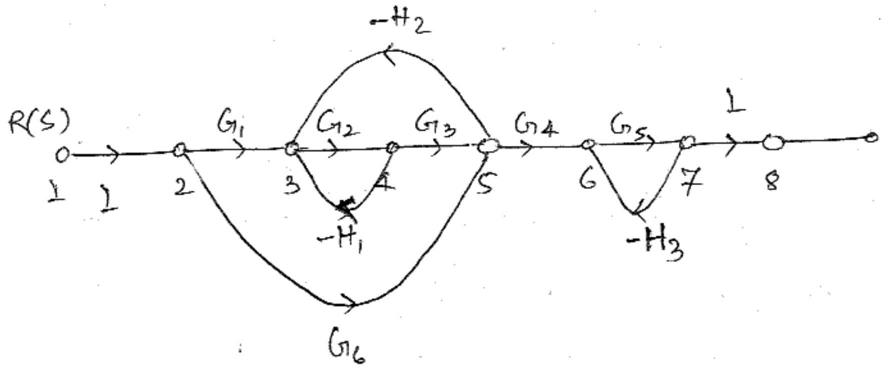
$T = T(s)$ = Transfer of the system.

P_K = Forward path ~~of the~~ gain of the K^{th} forward path

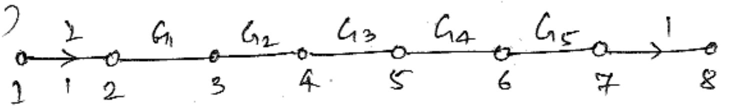
Δ = 1 - (Sum of individual loop gains)
+ (Sum of gain products of all possible combination of two non-touching loops)
- (Sum of gain products of all possible combination of three non-touching loops)
+ . . . . .

Δ_K = Δ for that part of the graph which is not touching the K^{th} forward path.

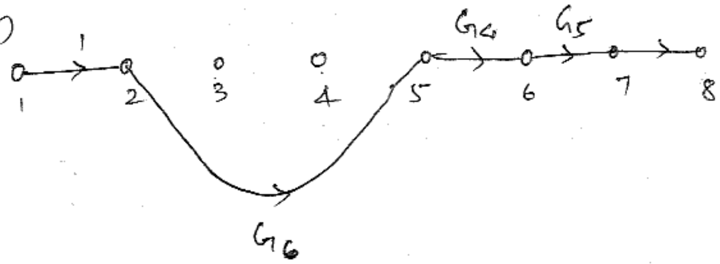
Find the overall transfer function of the system to whose signal flow graph is shown in the figure.



There are two forward paths : K=2



Forward path -1



good

Forward path -2

Let the forward path gains be P_1 & P_2.

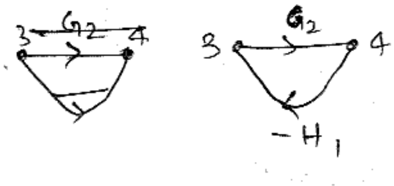
Gain of forward path -1, $P_1 = G_1 \cdot G_2 \cdot G_3 \cdot G_4 \cdot G_5$

" " " path -2, $P_2 = G_4 \cdot G_5 \cdot G_6$

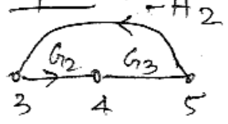
Step-2 :

Individual loop gains

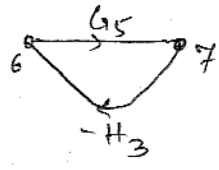
Loop-1 :



loop-2 :



loop-3 .



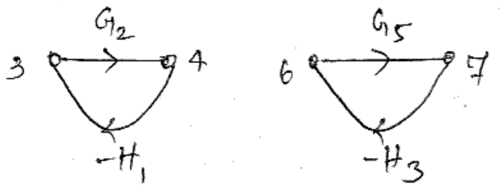
loop gain of loop-1, $P_{11} = -G_2H_1$

loop gain of loop-2, $P_{21} = -G_2G_3H_2$

" " " Loop-3, $P_{31} = -G_5H_3$

<u>Step-3</u>: Gain products of two non-touching loops: There are two combinations of two non-touching loops. Let the gain products be P_{12} and P_{22}.

First combination of two non-touching loops.



Gain $P_{12} = P_{11}P_{31} = -(G_2H_1)(-G_5H_3)$

$= G_2G_5H_1H_3$