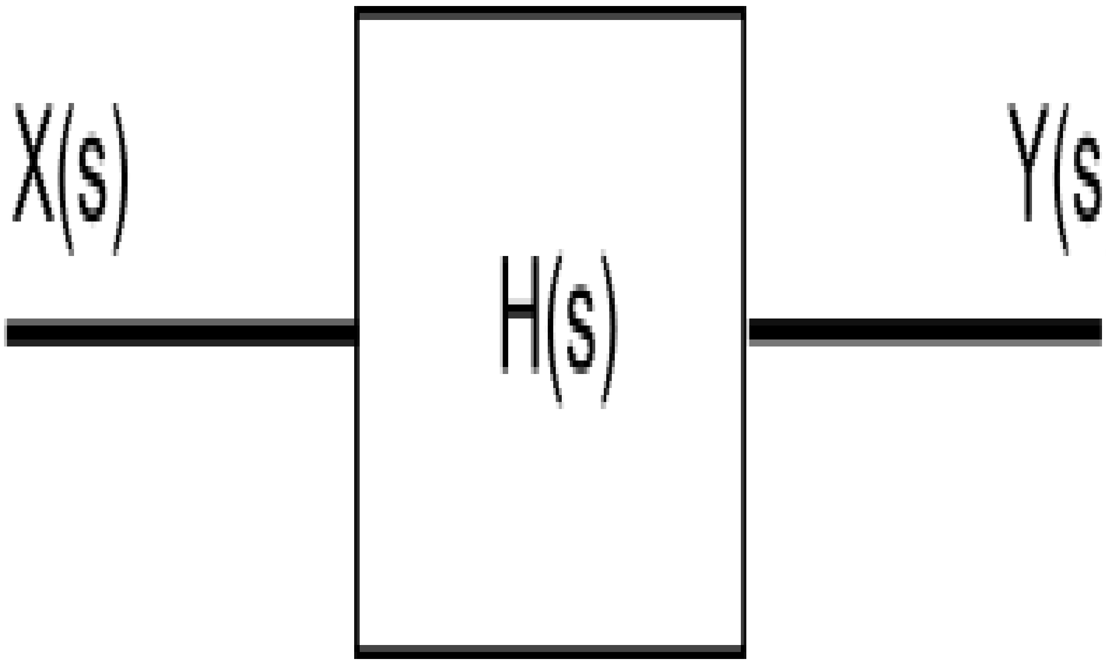
TRANSFER FUNCTIONS, BLOCK DIAGRAM ALGEBRA,

Transfer Functions

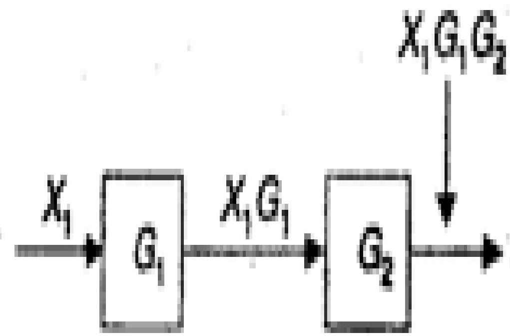
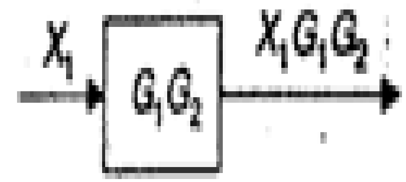
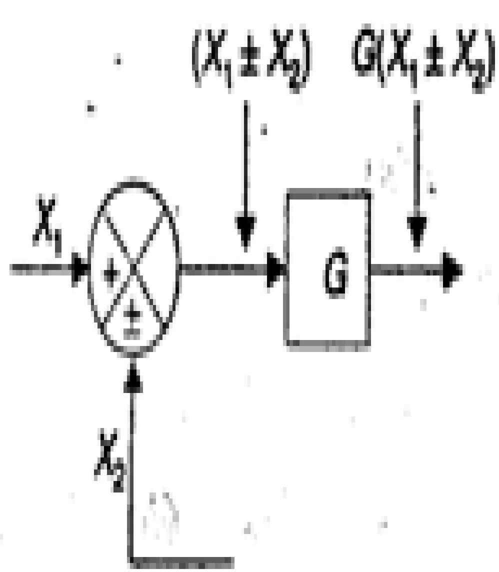
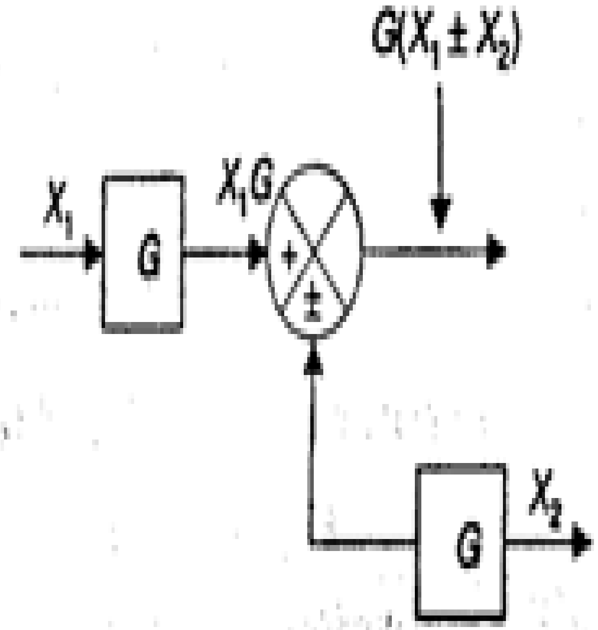
- A **Transfer Function** is the ratio of the output of a system to the input of a system, in the Laplace domain considering its initial conditions and equilibrium point to be zero. If we have an input function of *X(s)*, and an output function *Y(s)*, we define the transfer function *H(s)* to be
- H(s)=Y(s)/X(s)

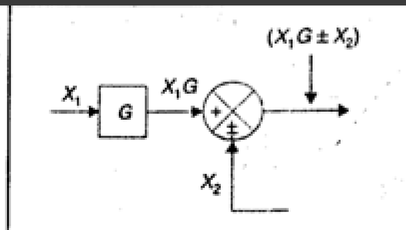
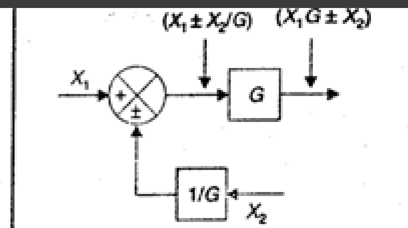
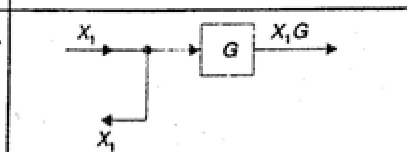
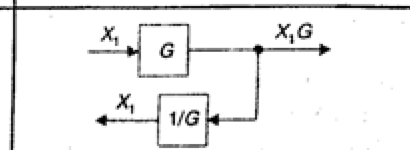
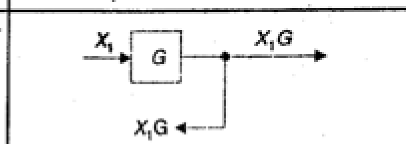
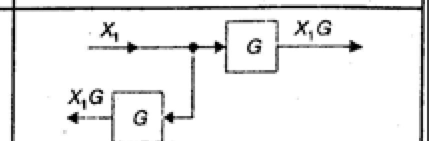
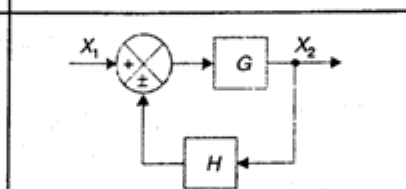
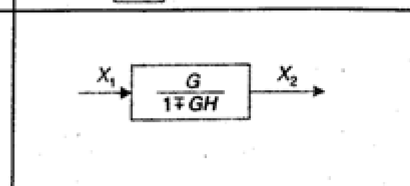
Readers who have read the Circuit Theory book will recognize the transfer function as being the impedance, admittance, impedance ratio of a voltage divider or the admittance ratio of a current divider.



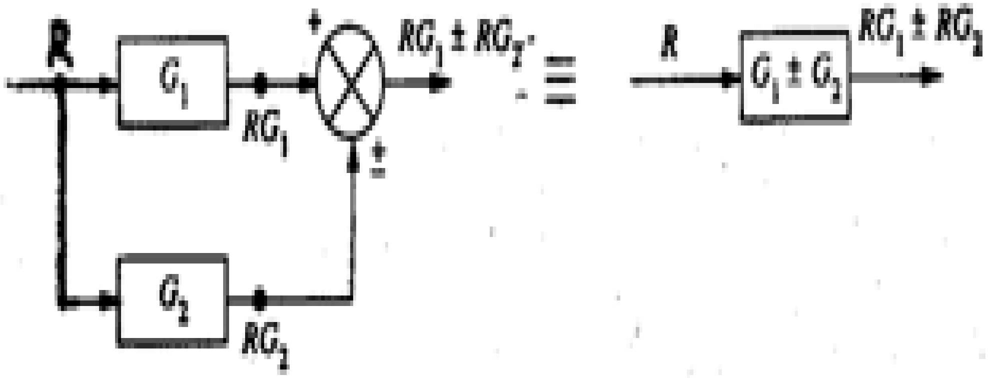
Block Diagram Algebra

- A complex system is represented by the interconnection of the blocks for individual elements. Evaluation of complex system requires simplification of block diagrams by block diagram rearrangement. Some of the important rules are given in figure below.

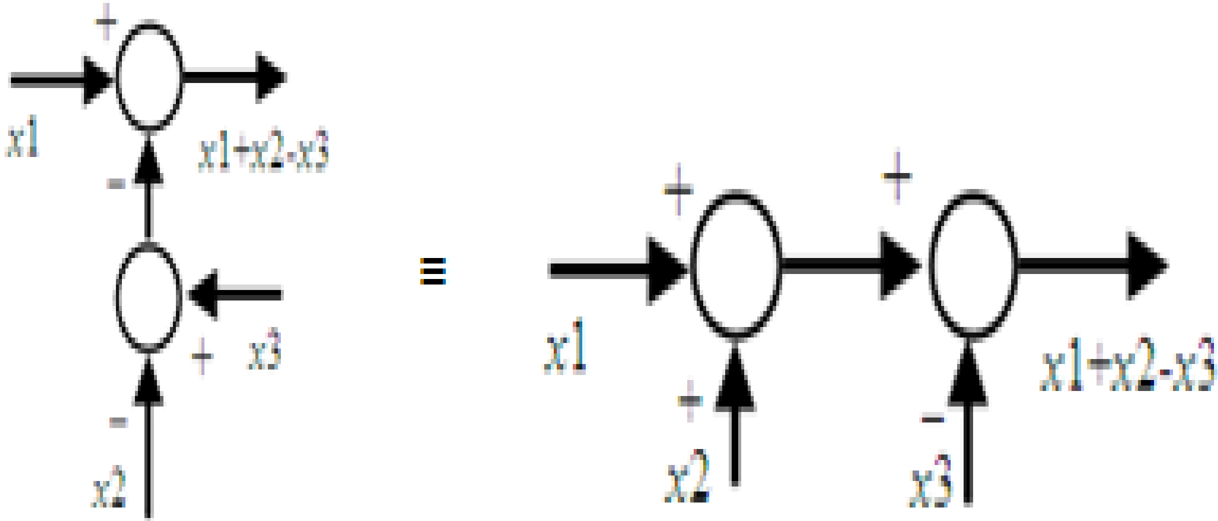
Rule	*Original diagram*	*Equivalent diagram*
1. Combining blocks in cascade		
2. Moving a summing point after a block		

3. Moving a summing point ahead of a block		
4. Moving a take off point after a block		
5. Moving a take off point ahead of a block		
6. Eliminating a feedback loop		

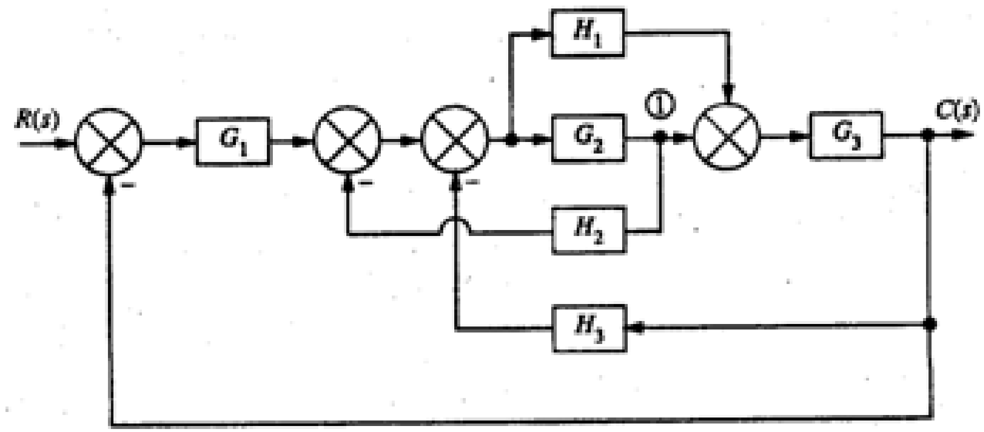
7. Combining Blocks in Parallel



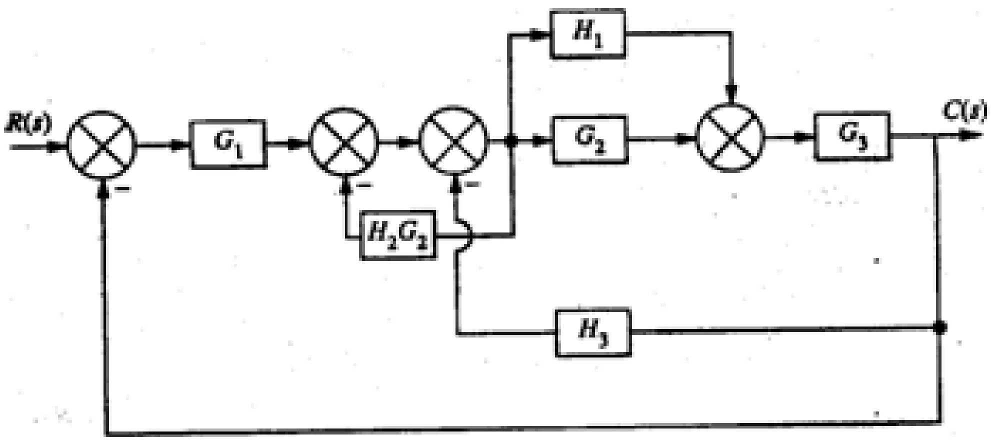
8. Moving summing point :

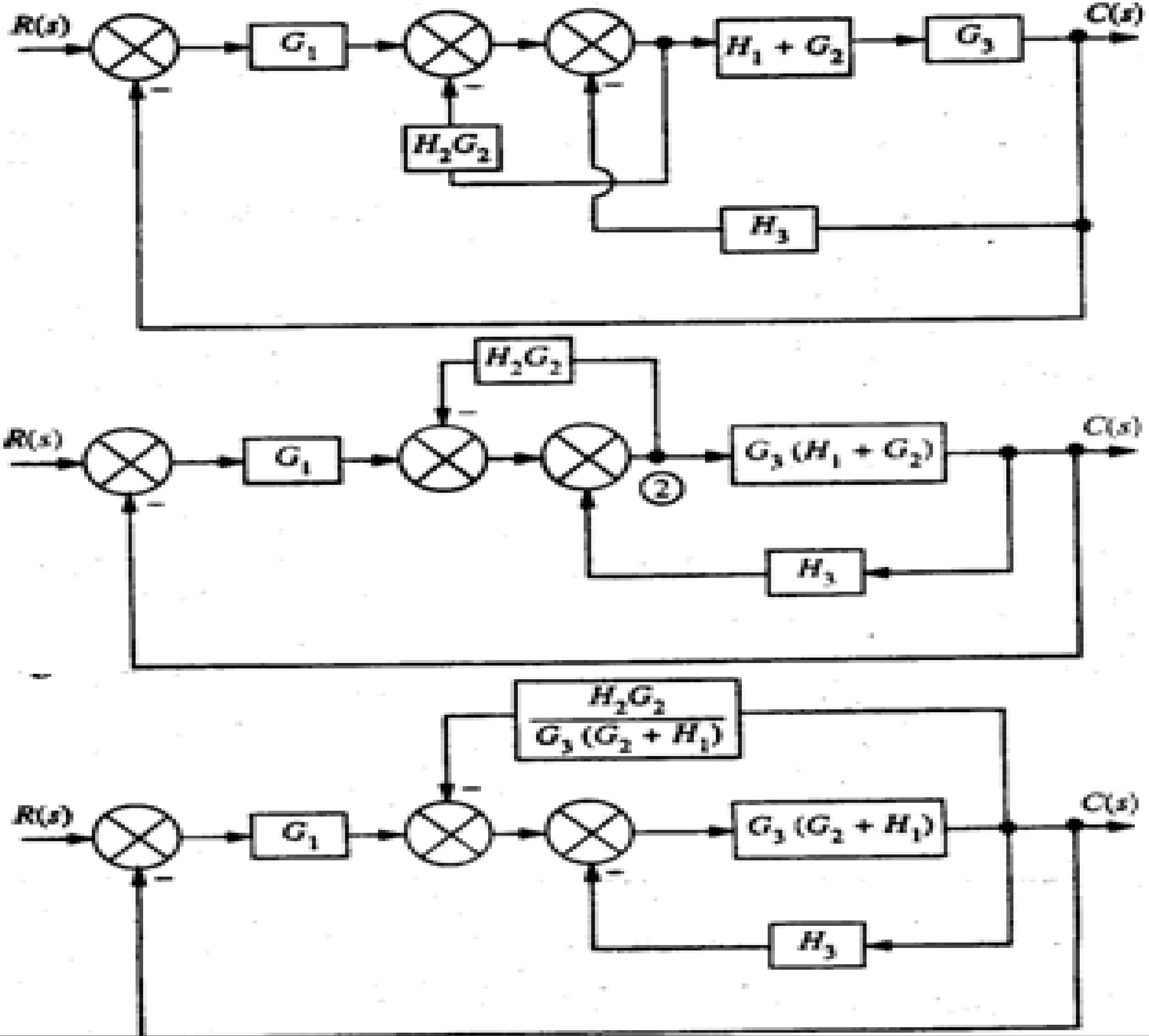


Example:-Simplify the block diagram shown in Figure below

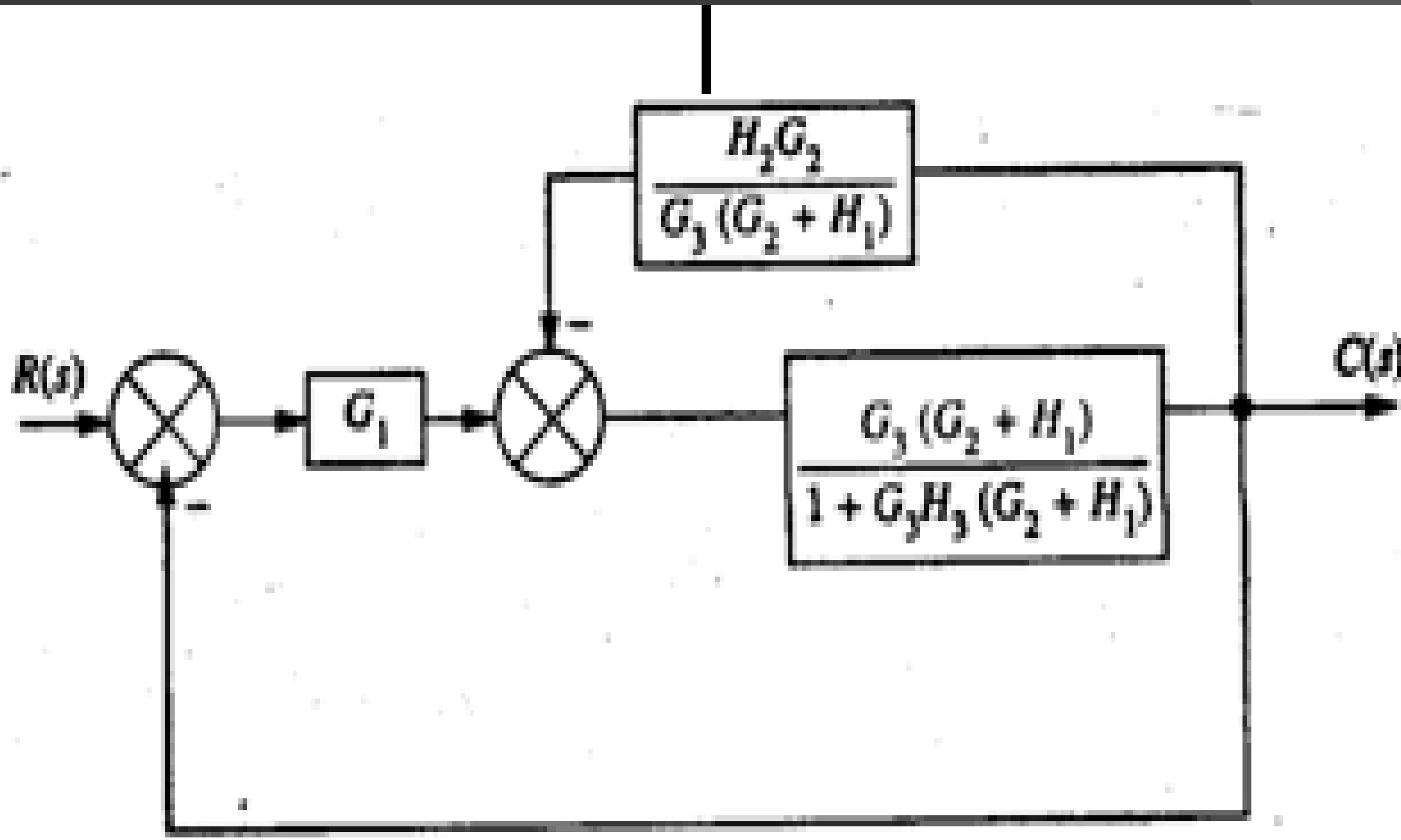


Solution:

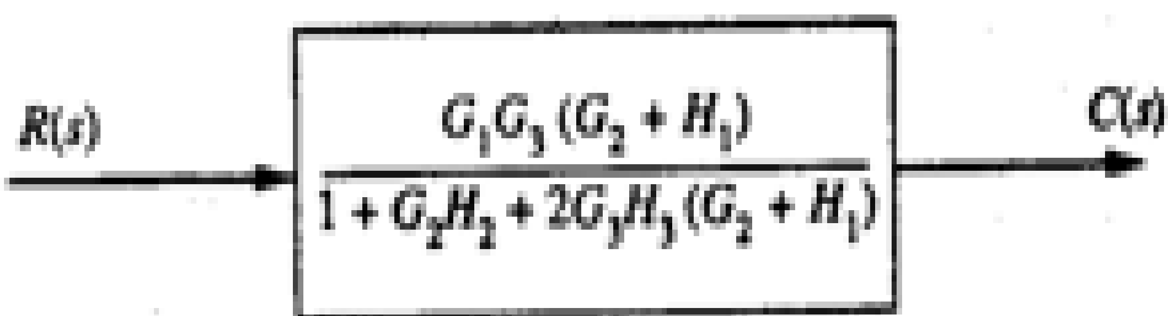




R(s)
G1
H1 + G2
G3
C(s)
H2G2
H3
R(s)
H2G2
G1
G3 (H1 + G2)
C(s)
2
H3
H2G2 / G3 (G2 + H1)
R(s)
G1
G3 (G2 + H1)
C(s)
H3



$\frac{H_2G_2}{G_3(G_2+H_1)}$
R(s)
G_1
$\frac{G_3(G_2+H_1)}{1+G_3H_3(G_2+H_1)}$
C(s)



R(s)
$\frac{G_1G_3(G_2+H_1)}{1+G_2H_2+2G_3H_3(G_2+H_1)}$
C(s)