

2.5. Block Diagrams

a block diagram of a system is a pictorial representation of the functions performed by each component of the flow signal.

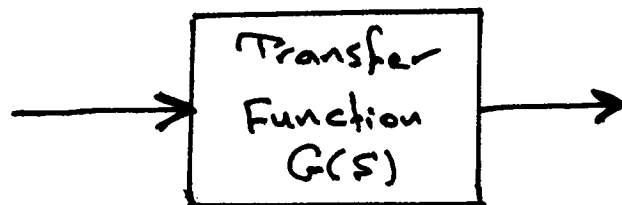


fig. element of a block diagram

open loop transfer function

The ratio of the feedback signal $B(s)$ to the error signal $E(s)$

$$\text{open loop transfer function} = \frac{B(s)}{E(s)} = G(s)H(s)$$

Feed - Forward transfer function

The ratio of the output $C(s)$ to the error signal $E(s)$

$$\text{Feed - forward transfer function} = \frac{C(s)}{E(s)} = G(s)$$

Close loop transfer function

The ratio of the output $C(s)$ to the input $R(s)$

$$C(s) = G(s) E(s)$$

$$E(s) = R(s) \mp B(s)$$

$$= R(s) \mp H(s) C(s)$$

$$C(s) = G(s) [R(s) \mp H(s) C(s)]$$

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 \pm G(s) H(s)}$$

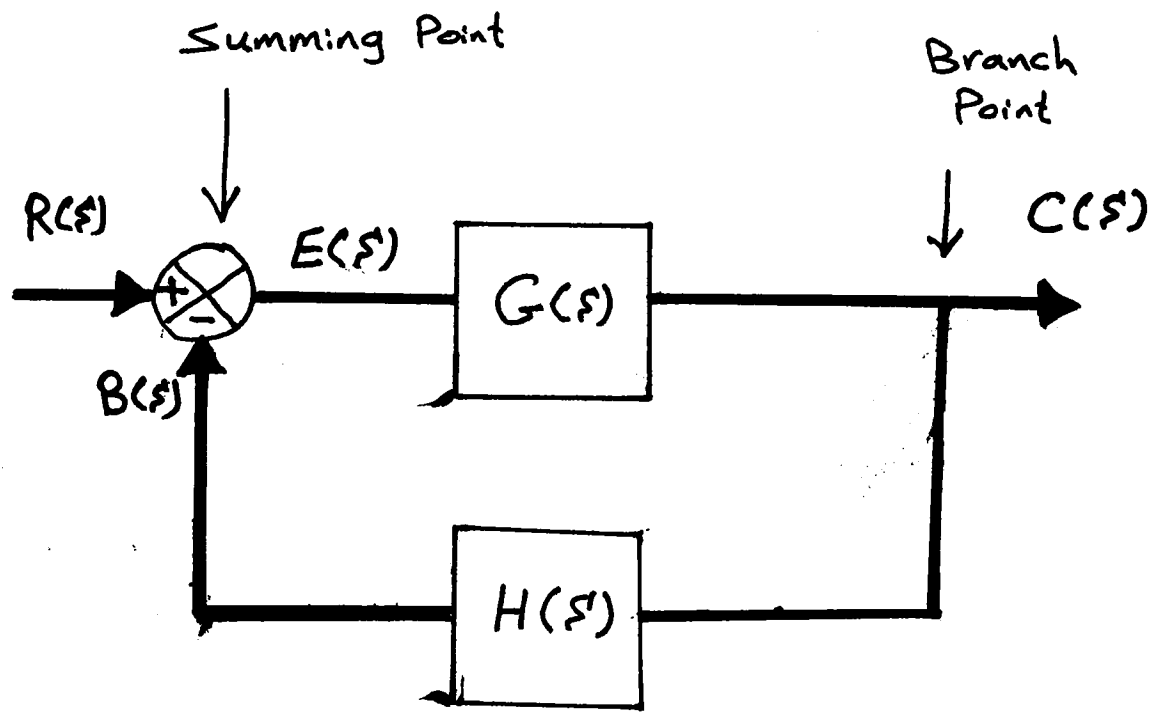
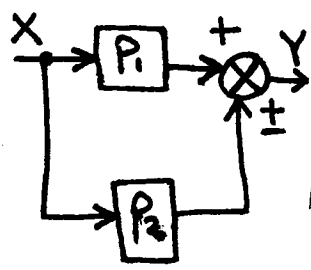
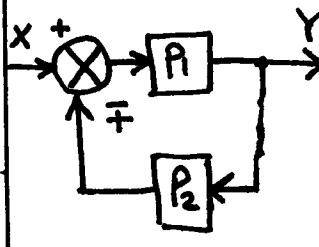
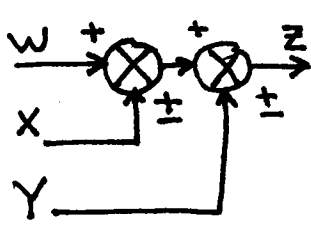
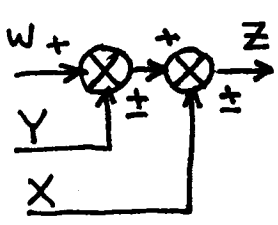
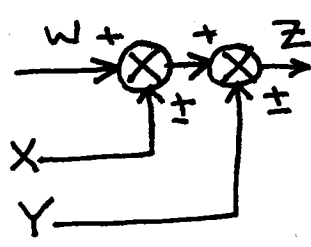
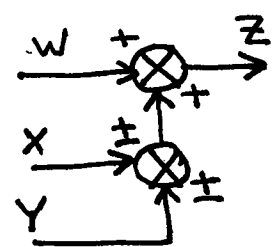
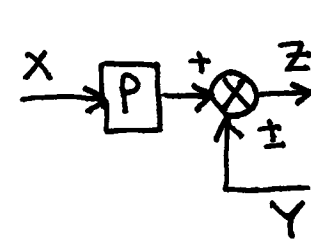
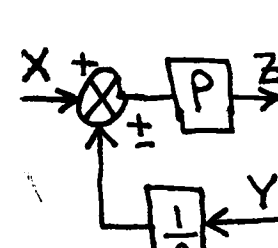
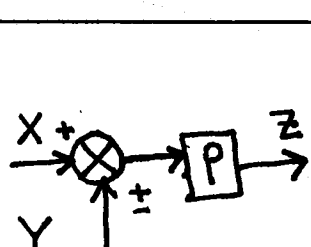
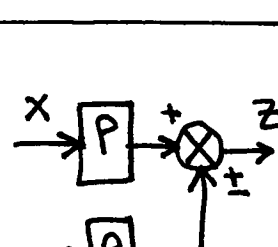
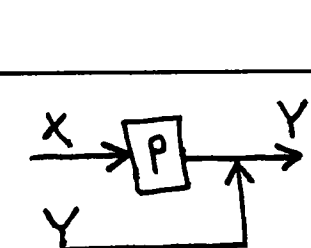
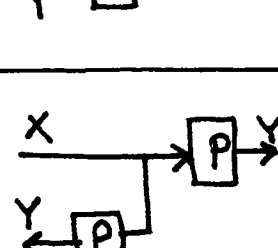
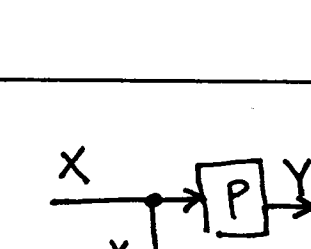
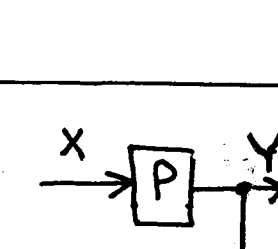


Fig. closed loop system

2.6. Block Diagram Reduction ::

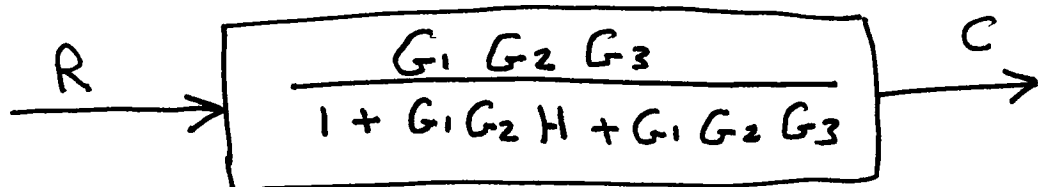
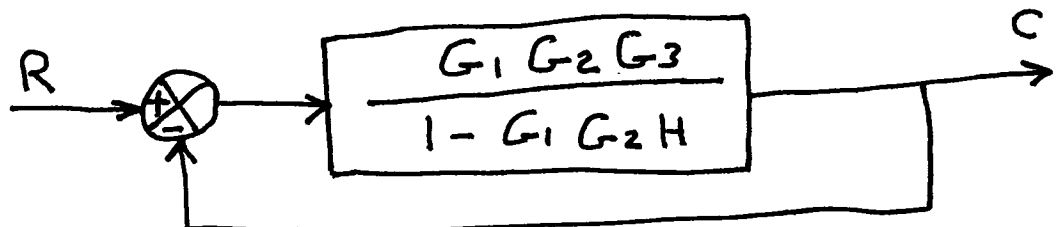
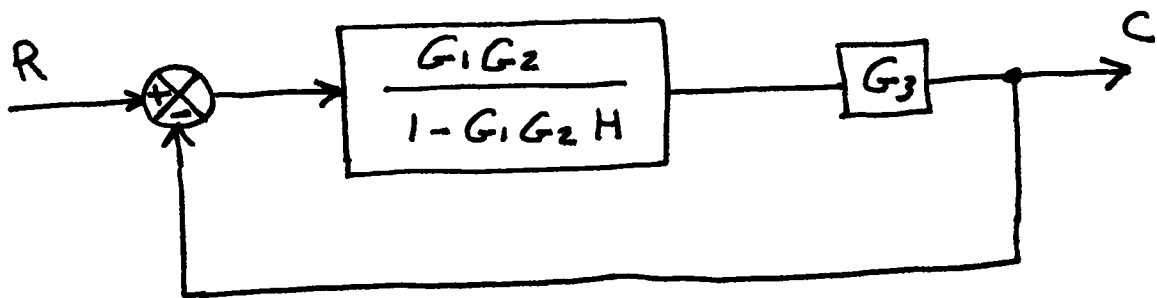
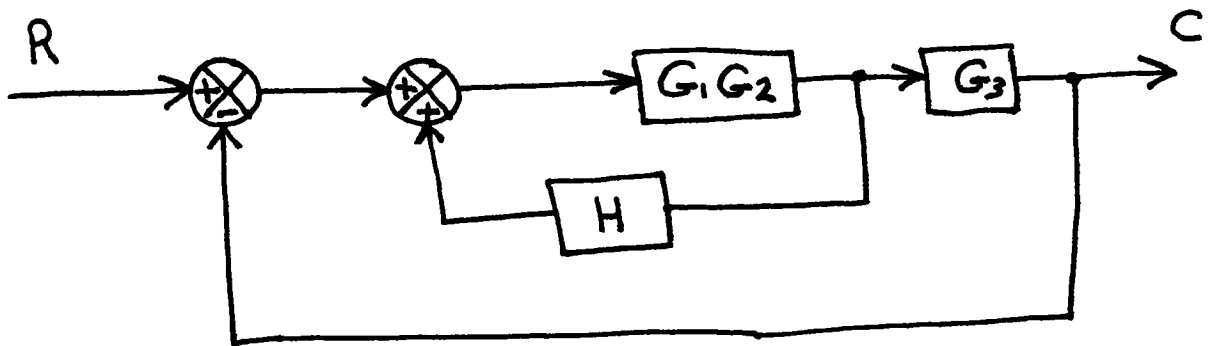
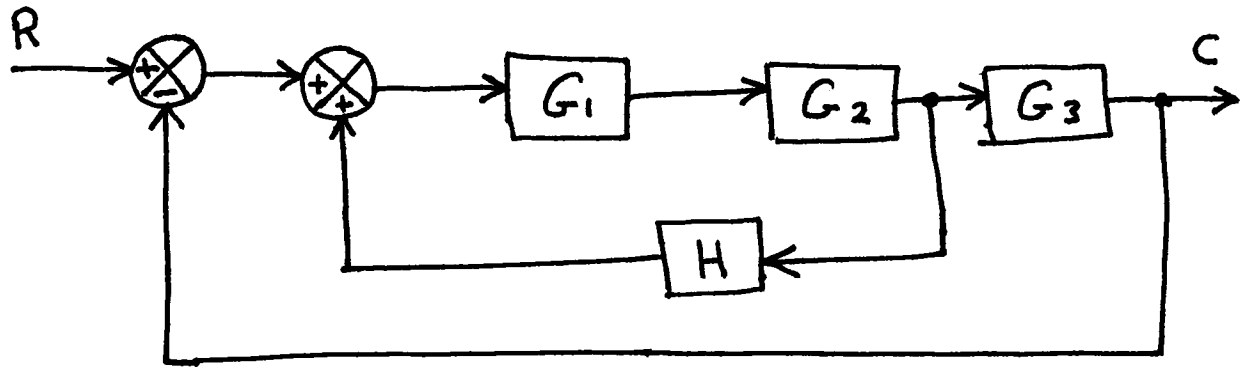
a complicated block diagram involving many feed back loops can be simplified by a step-by-step arrangement using the following rules

Transformation		Equation	Block diagram	Equivalent Block diagram
1	Combining block in cascade	$Y = (P_1 P_2) X$	$X \rightarrow [P_1] \rightarrow [P_2] \rightarrow Y$	$X \rightarrow [P_1 P_2] \rightarrow Y$
2	Combining blocks in Parallel or Elimination of forward loop	$Y = P_1 X \mp P_2 X$		$X \rightarrow [P_1 \pm P_2] \rightarrow Y$
3	Eliminating a feedback loop	$Y = P_1 (X \mp P_2 Y)$		$X \rightarrow \left[\frac{P_1}{1 \pm P_1 P_2} \right] \rightarrow Y$

4	Rearrange Summing Point	$Z = W \pm X \pm Y$		
5	Rearrange Summing Point	$Z = W \pm X \pm Y$		
6	Moving Summing Point Ahead of a Block	$Z = PX \pm Y$		
7	Moving Summing Point beyond of a Block	$Z = P(X \pm Y)$		
8	Moving a take off Point Ahead of a block	$Y = PX$		
9	Moving a take off Point beyond a block	$Y = PX$		

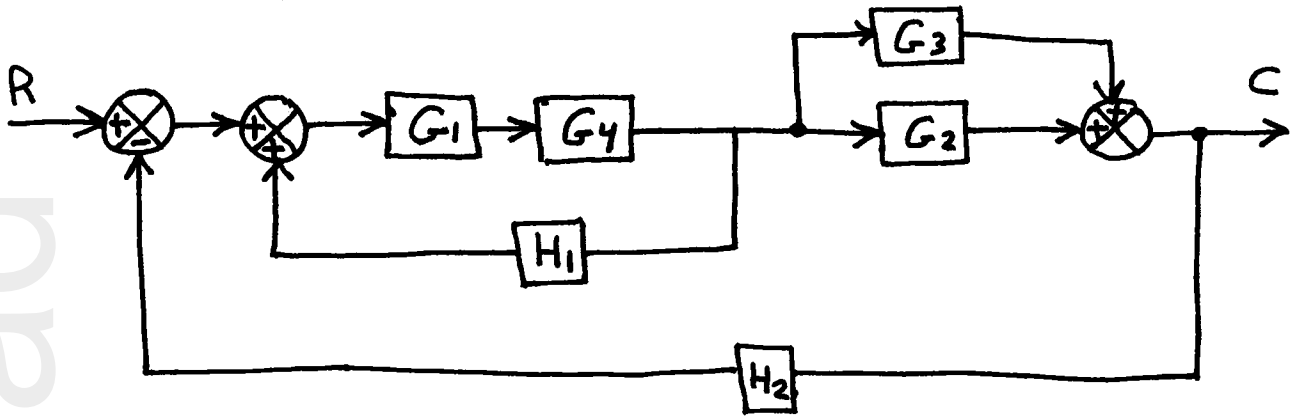
Example 20

Simplify the block diagram shown below

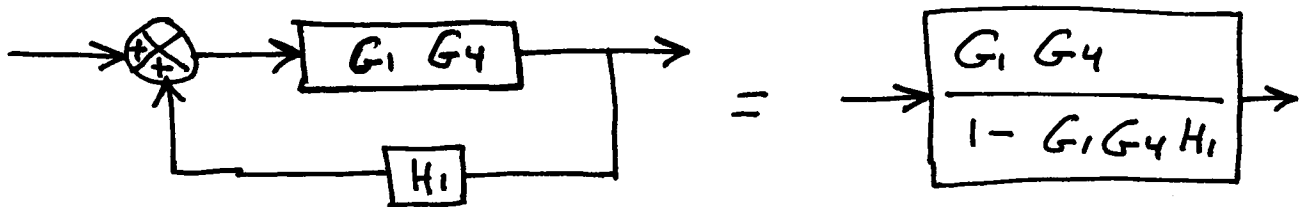
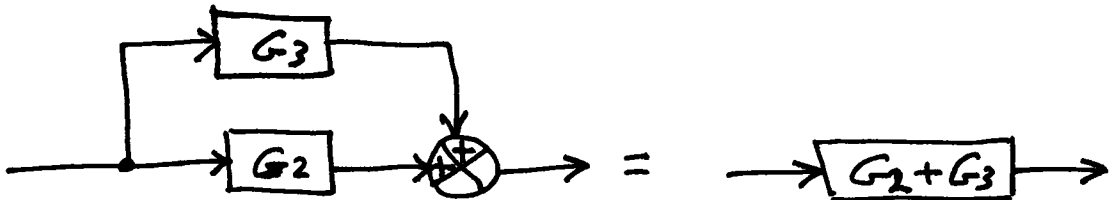
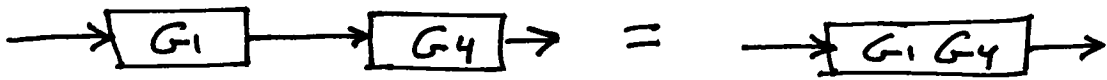


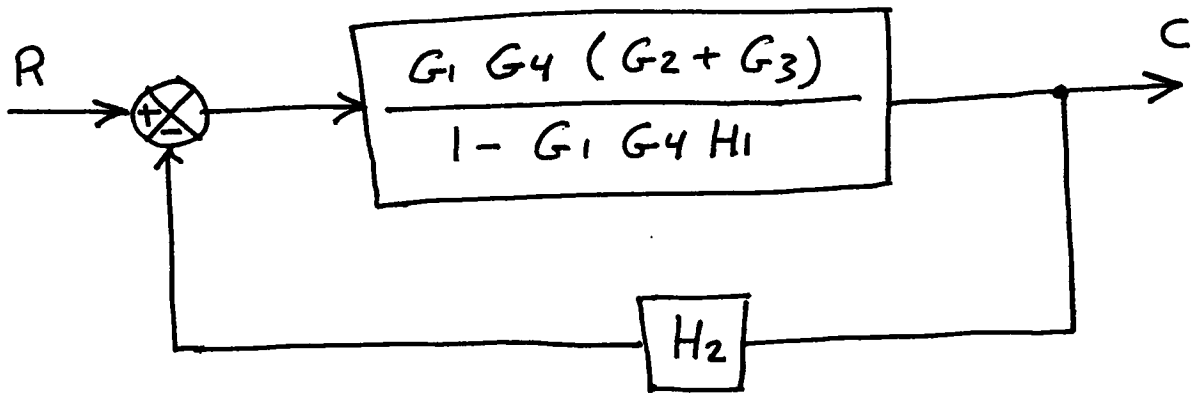
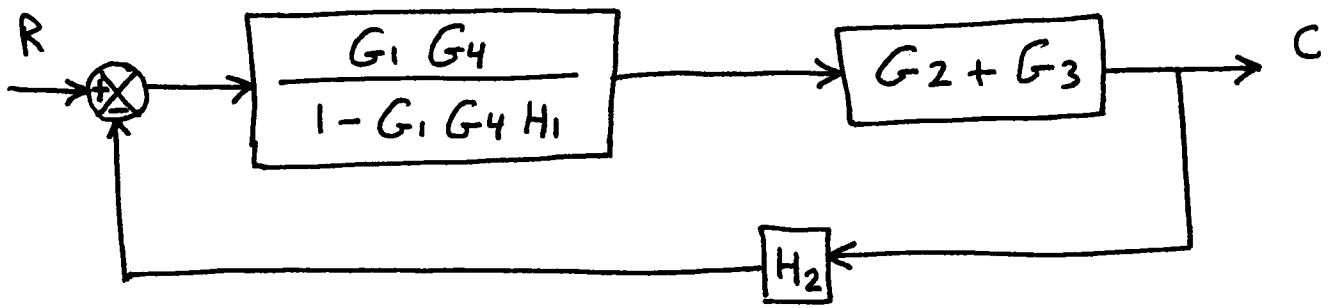
Example :

Simplify the block diagram shown below?



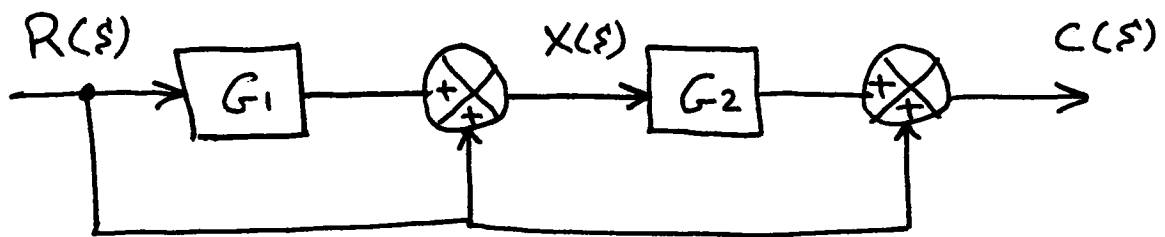
Solution



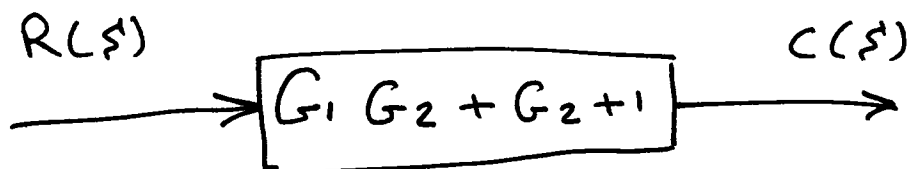
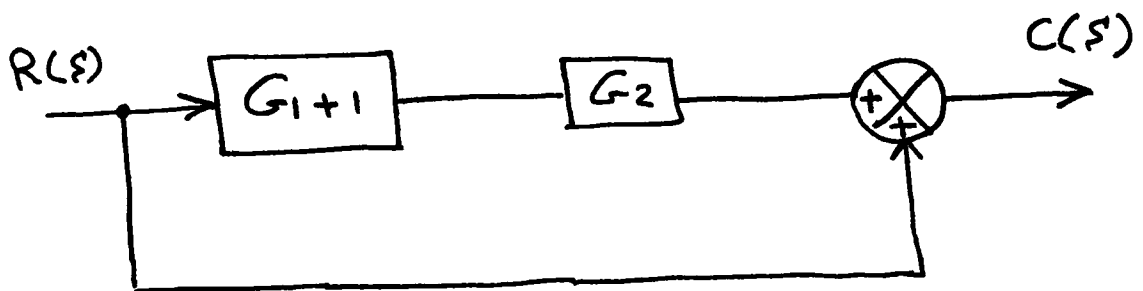
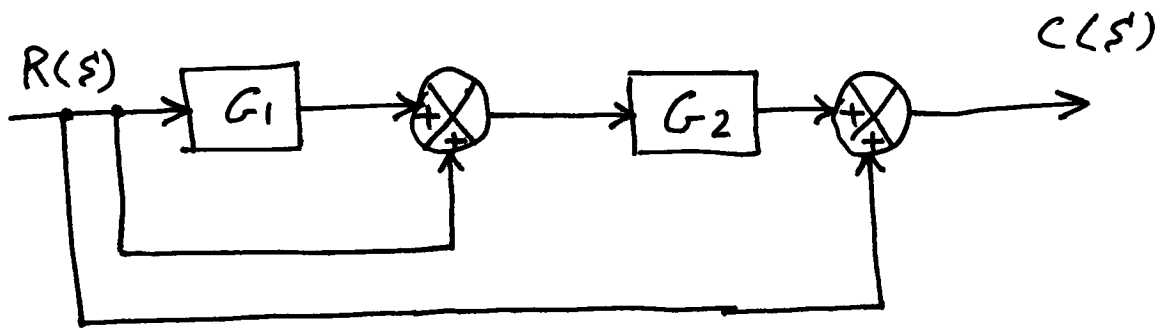


Example 80

Simplify the block diagram shown below

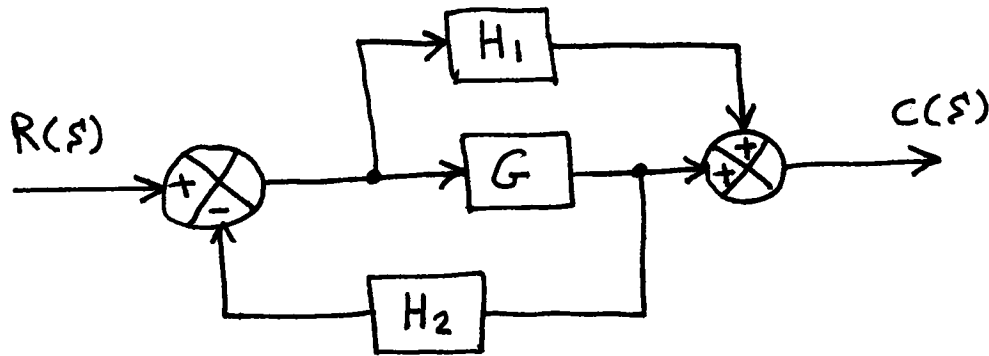


Solution 80

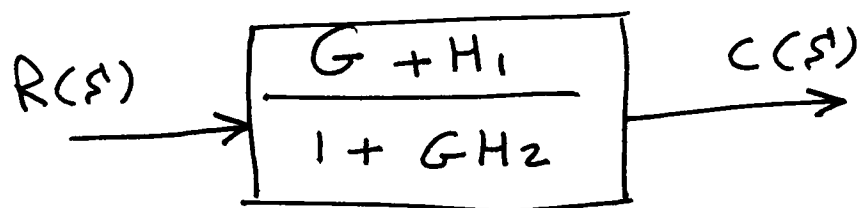
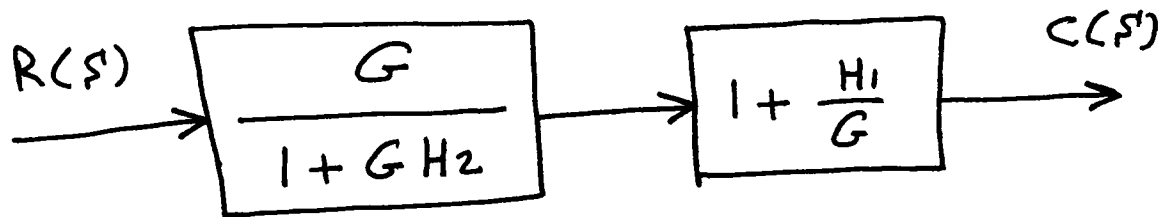
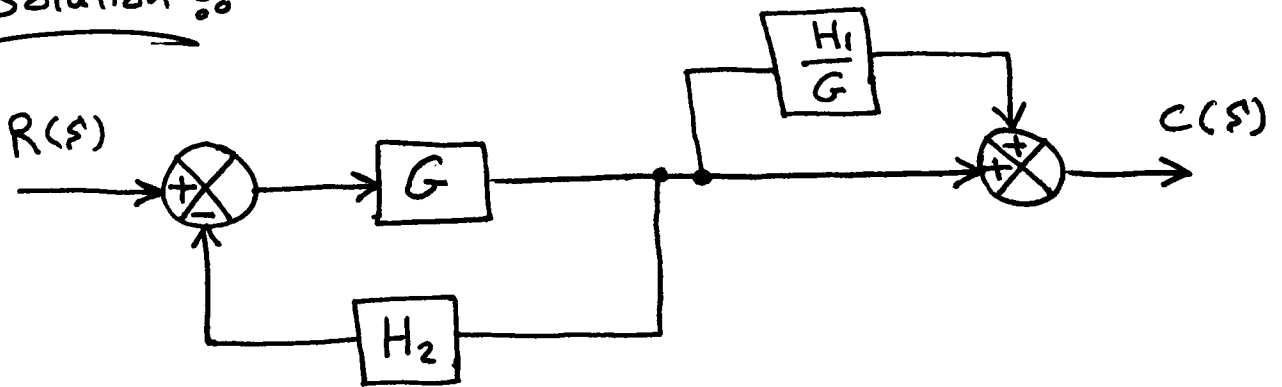


Example 80

Simplify the block diagram shown below

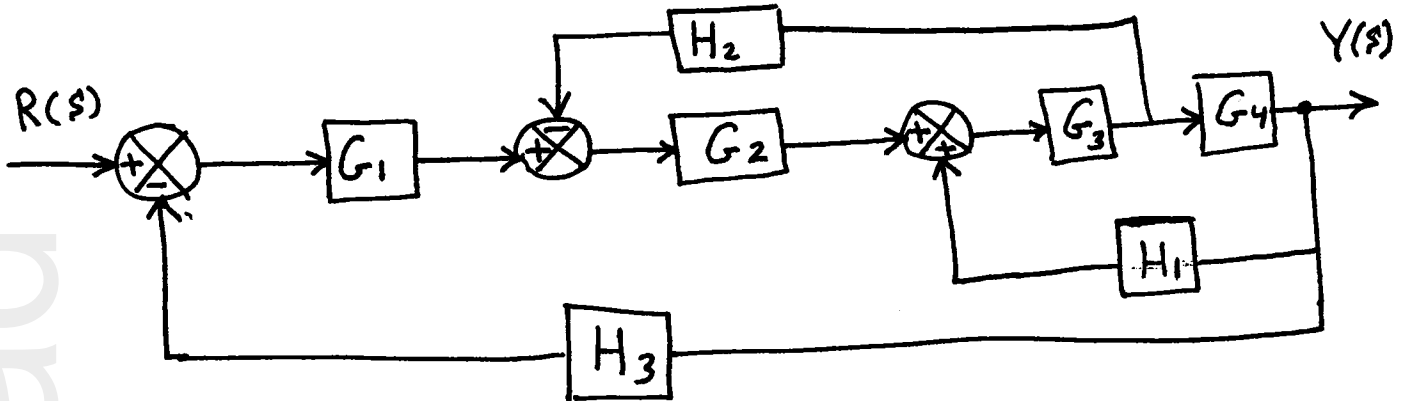


Solution 80



H.W

Simplify the block diagram shown below



Ans.

$$\frac{G_1 G_2 G_3 G_4}{1 - G_3 G_4 H_1 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_3}$$