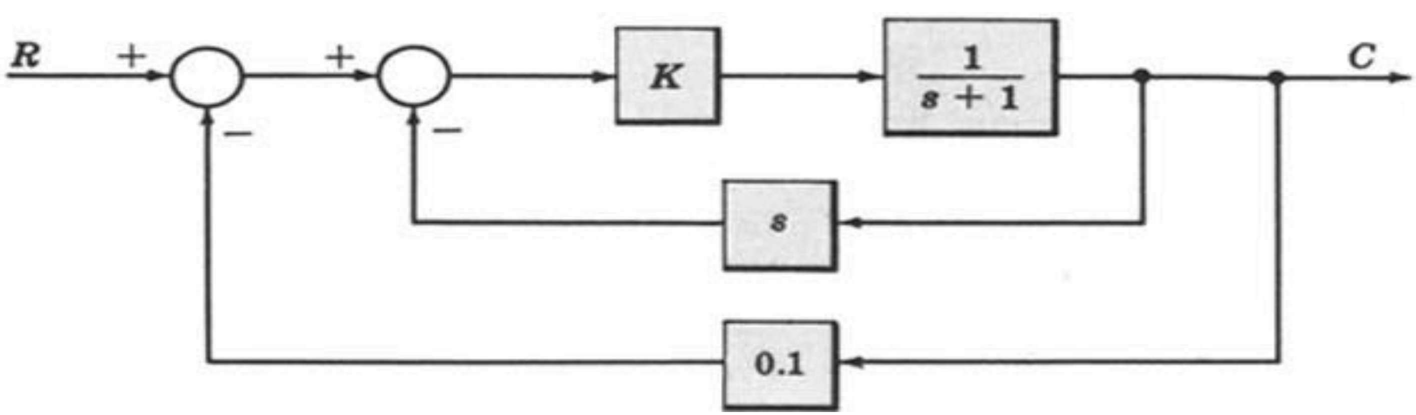
Problems On Block Diagram Reduction Techniques

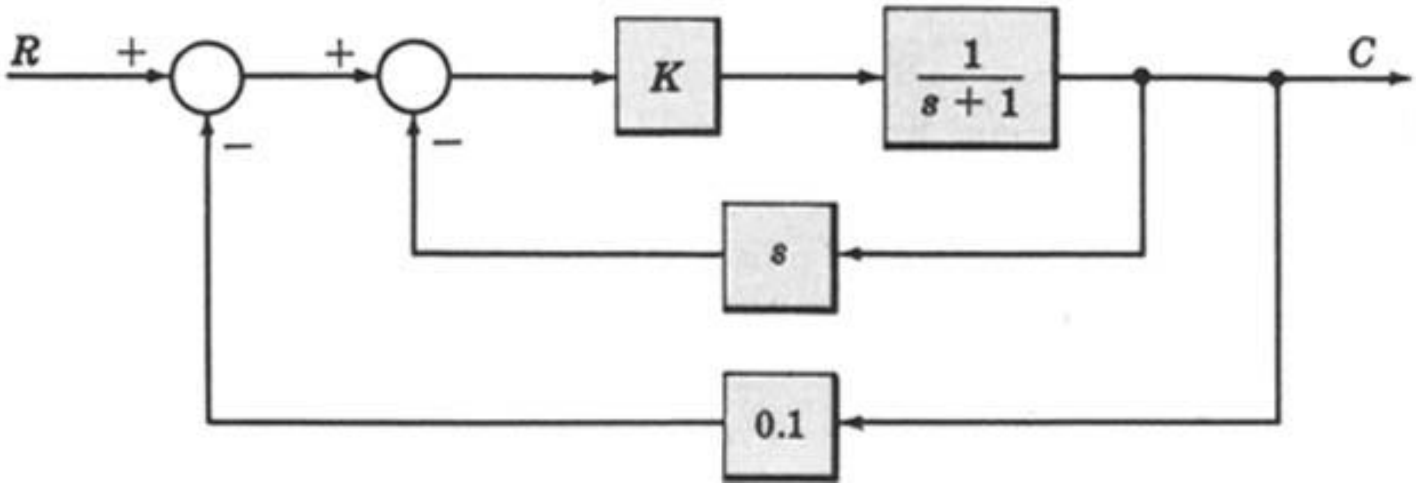
Example-8: For the system represented by the following block diagram determine:

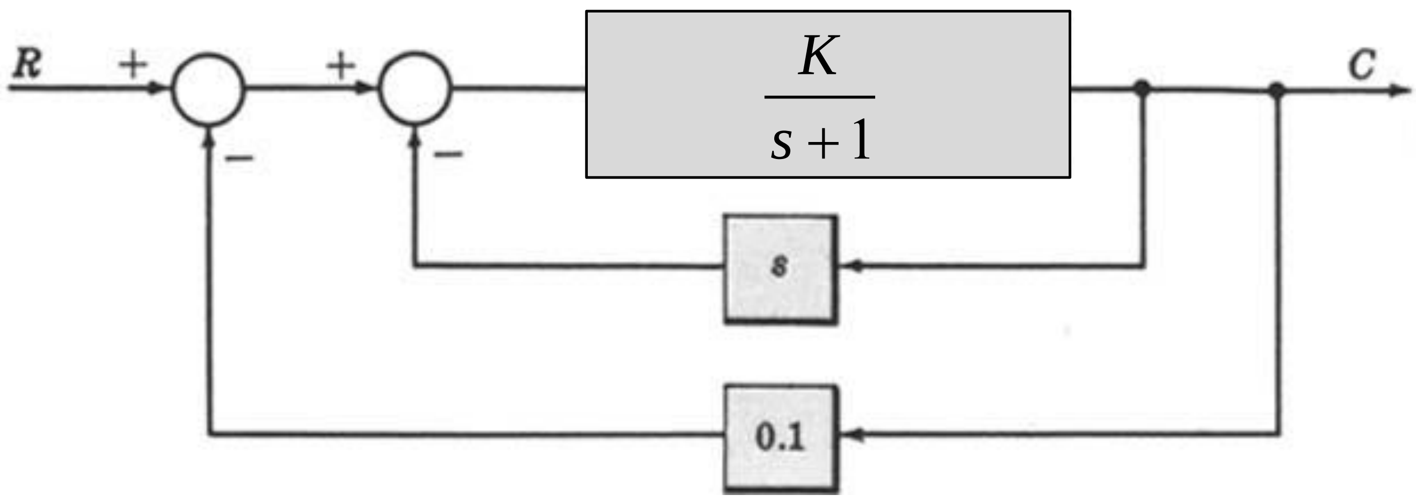
1. Open loop transfer function
2. Feed Forward Transfer function
3. control ratio
4. feedback ratio
5. error ratio
6. closed loop transfer function
7. characteristic equation
8. closed loop poles and zeros if K=10.



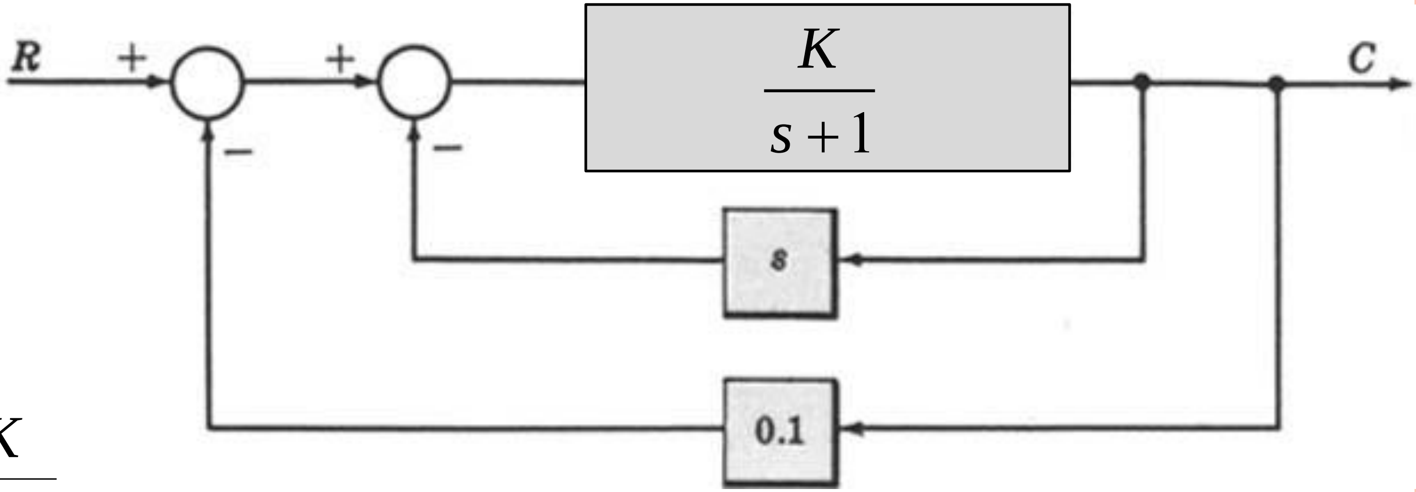
EXAMPLE-8: CONTINUE

- First we will reduce the given block diagram to canonical form

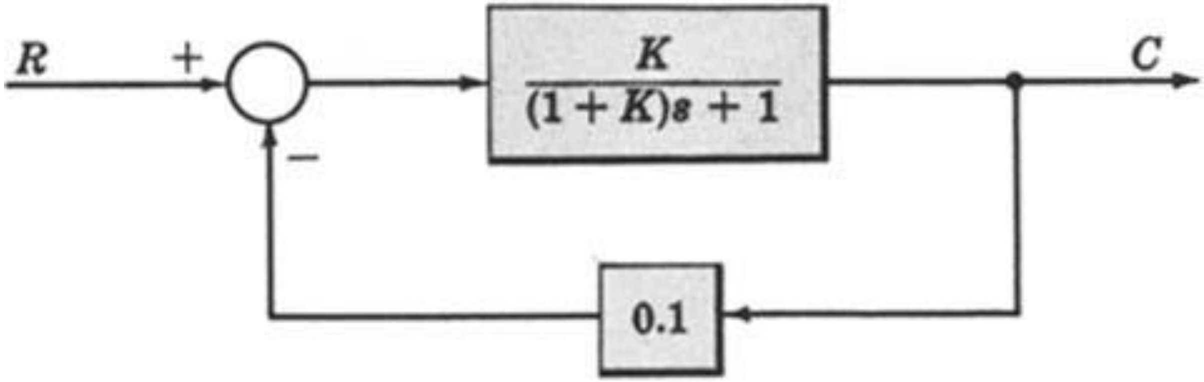




Example-8: Continue



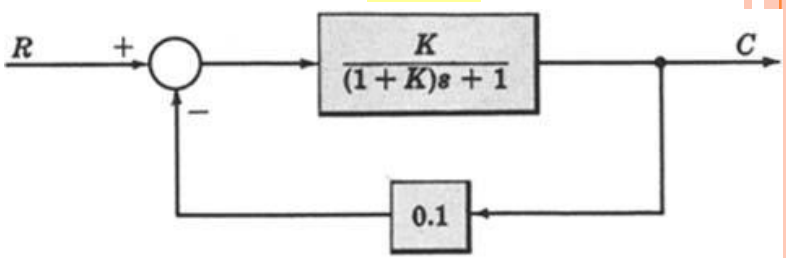
$$\frac{G}{1+GH}=\frac{\dfrac{K}{s+1}}{1+\dfrac{K}{s+1}s}$$



EXAMPLE-8: CONTINUE

1. Open loop transfer functior $\dfrac{B(s)}{E(s)} = G(s)H(s)$
2. Feed Forward Transfer functi $\dfrac{C(s)}{E(s)} = G(s)$
3. control ratio $\dfrac{C(s)}{R(s)} = \dfrac{G(s)}{1+G(s)H(s)}$
4. feedback ratio $\dfrac{B(s)}{R(s)} = \dfrac{G(s)H(s)}{1+G(s)H(s)}$
5. error ratio $\dfrac{E(s)}{R(s)} = \dfrac{1}{1+G(s)H(s)}$
6. closed loop transfer functior $\dfrac{C(s)}{R(s)} = \dfrac{G(s)}{1+G(s)H(s)}$
7. characteristic equatio $1+G(s)H(s) = 0$
8. closed loop poles and zeros if K=10.

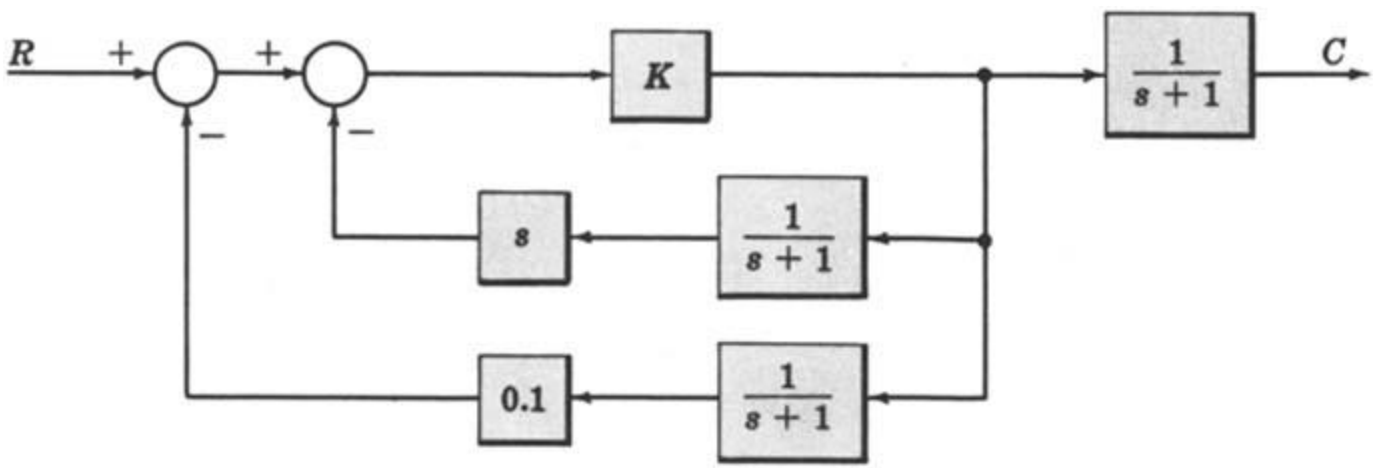
$G(s)$



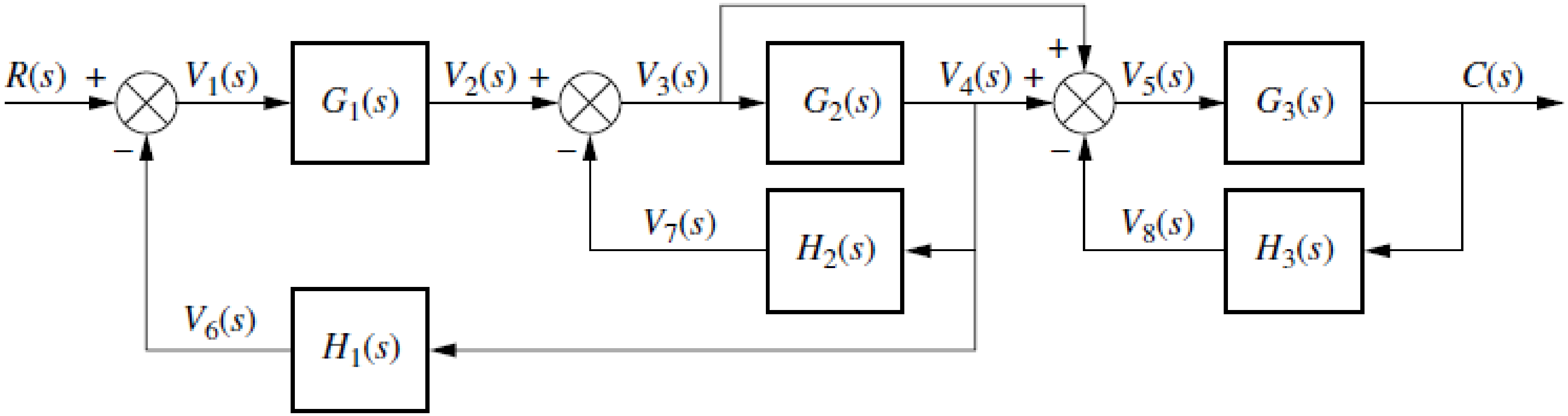
$H(s)$

Example-9: For the system represented by the following block diagram determine:

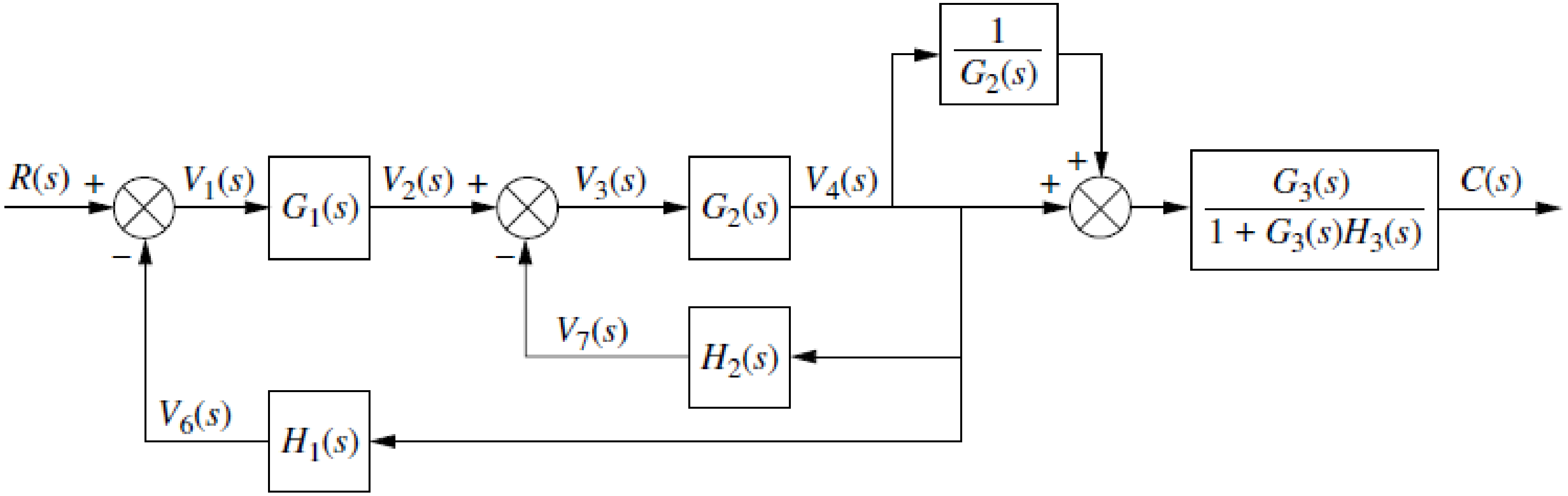
1. Open loop transfer function
2. Feed Forward Transfer function
3. control ratio
4. feedback ratio
5. error ratio
6. closed loop transfer function
7. characteristic equation
8. closed loop poles and zeros if K=100.



Example-10: Reduce the system to a single transfer function.

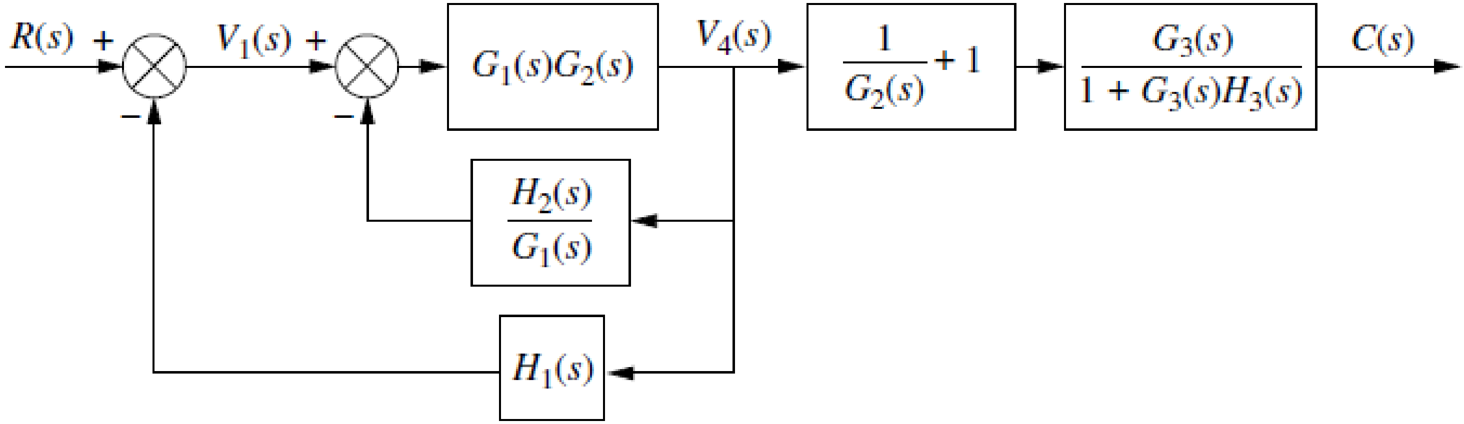


First, move $G_2(s)$ to the left past the pickoff point to create parallel subsystems, and reduce the feedback system consisting of $G_3(s)$ and $H_3(s)$.

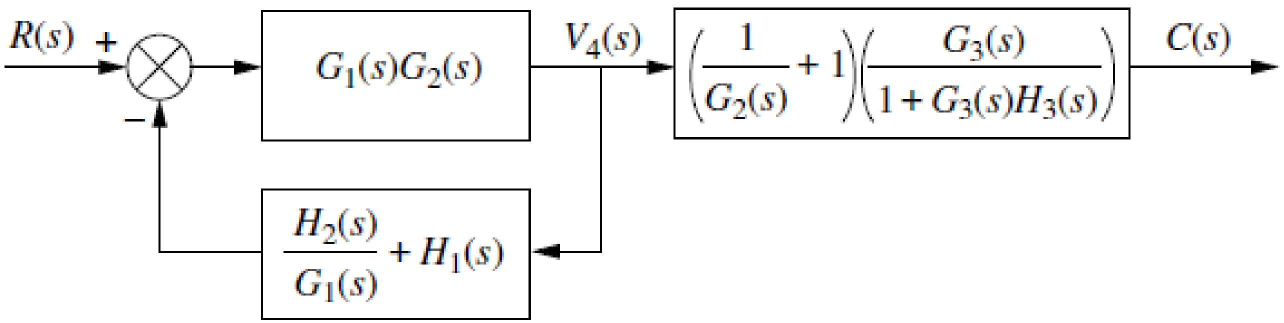


EXAMPLE-10: CONTINUE.

Second, reduce the parallel pair consisting of $1/G_2(s)$ and unity, and push $G_1(s)$ to the right past the summing junction, creating parallel subsystems in the feedback.

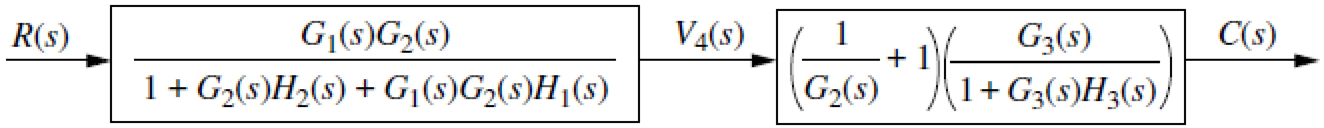


Third, collapse the summing junctions, add the two feedback elements together, and combine the last two cascaded blocks.

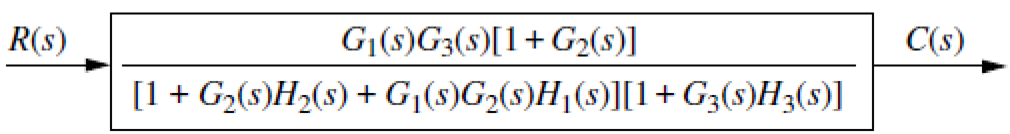


EXAMPLE-10: CONTINUE.

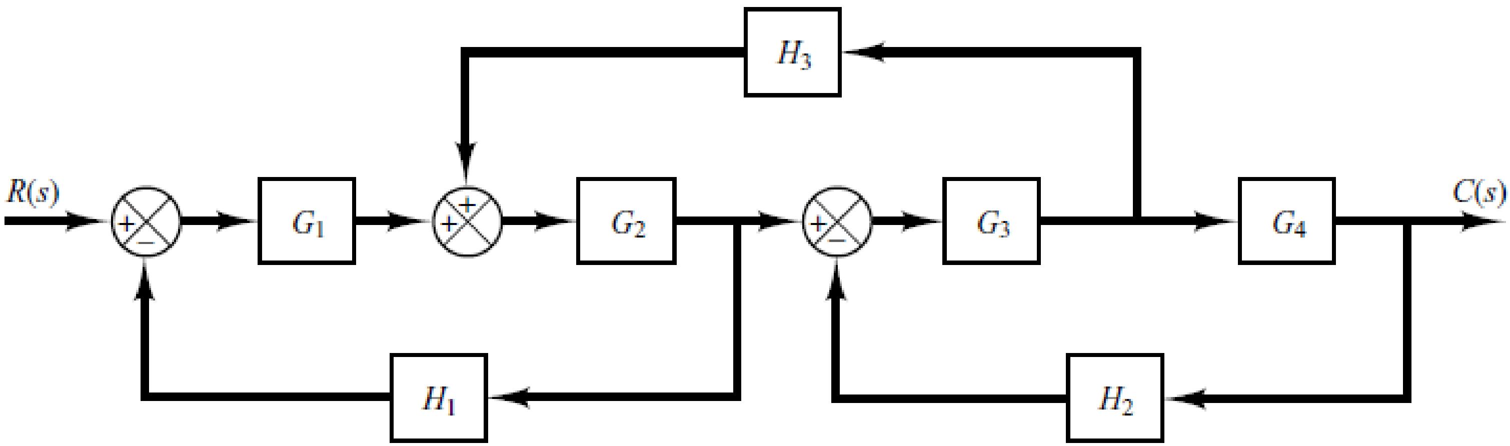
Fourth, use the feedback formula to obtain Figure



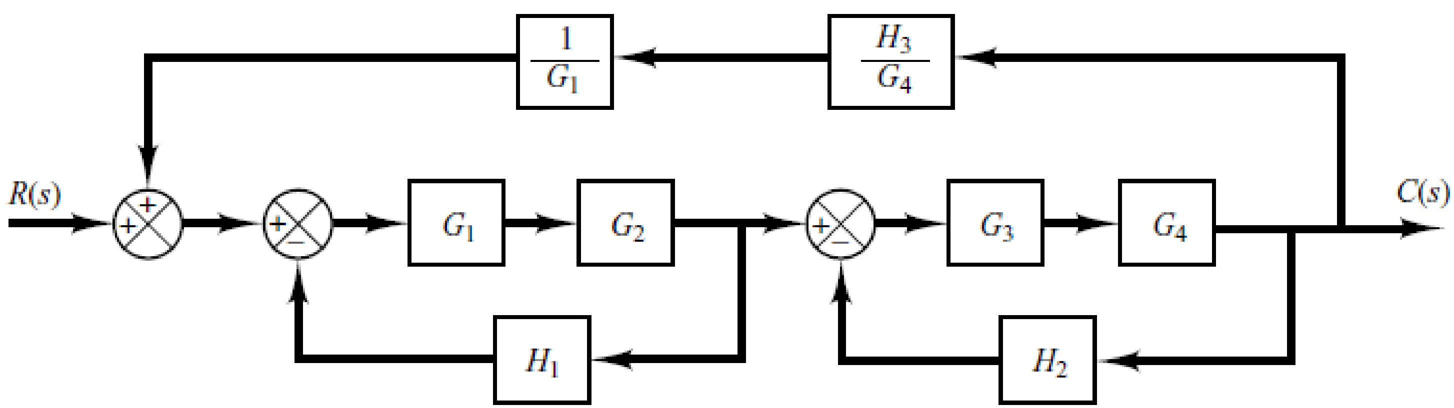
Finally, multiply the two cascaded blocks and obtain the final result,



EXAMPLE-11: SIMPLIFY THE BLOCK DIAGRAM THEN OBTAIN THE CLOSE-LOOP TRANSFER FUNCTION C(S)/R(S).

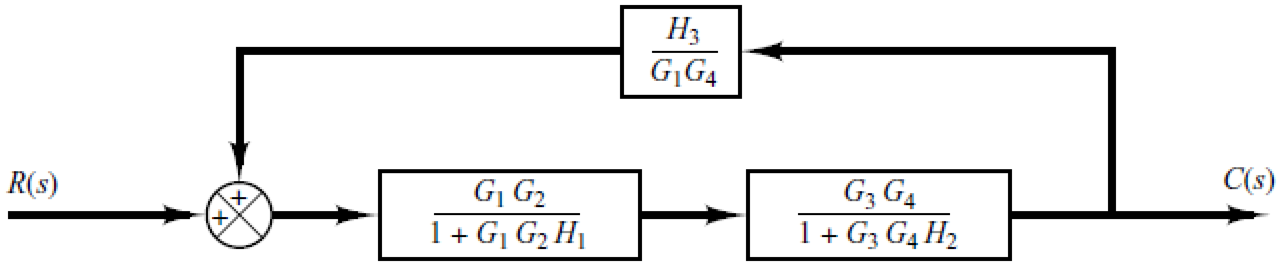


First move the branch point between G_3 and G_4 to the right-hand side of the loop containing G_3, G_4, and H_2. Then move the summing point between G_1 and G_2 to the left-hand side of the first summing point.

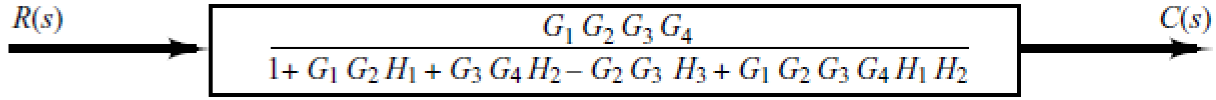


EXAMPLE-11: CONTINUE.

By simplifying each loop, the block diagram can be modified as



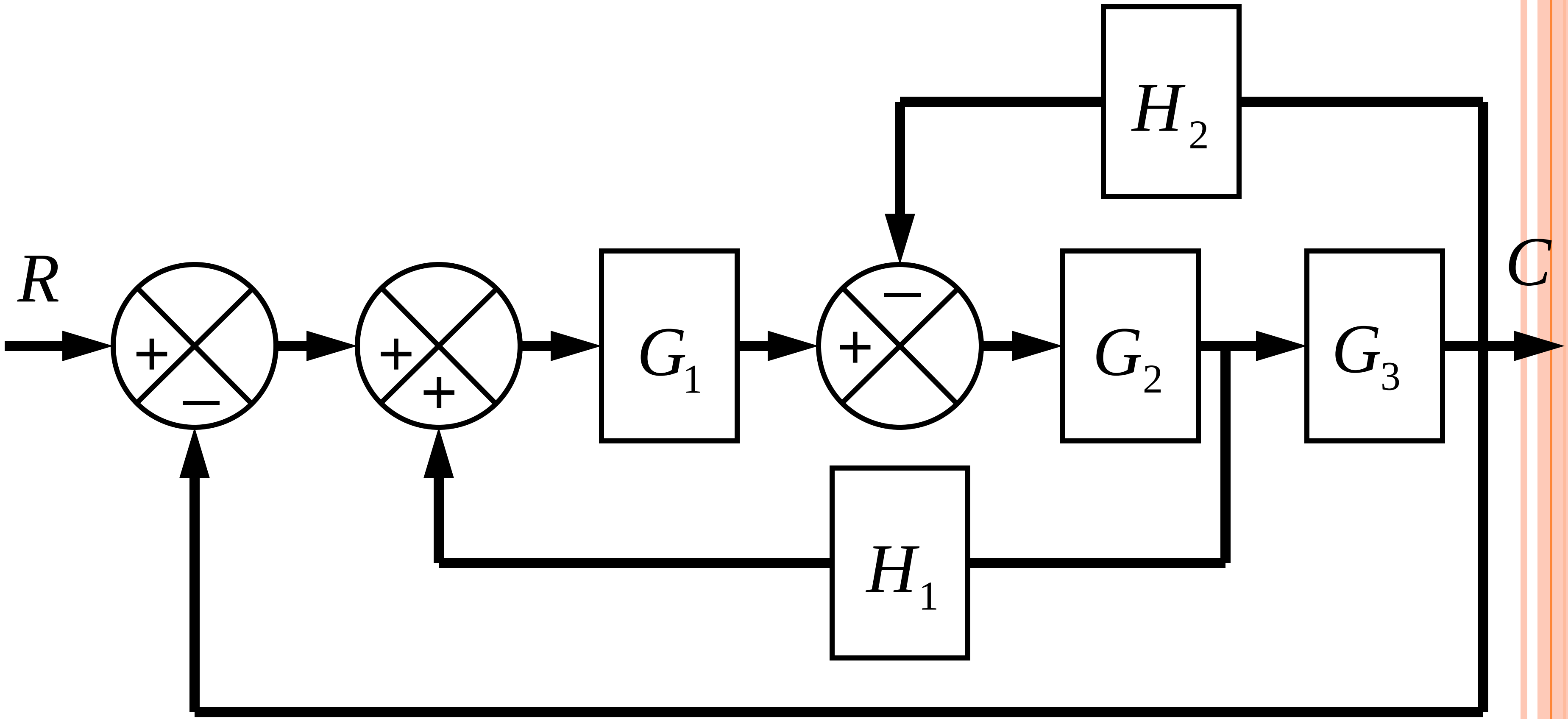
Further simplification results in



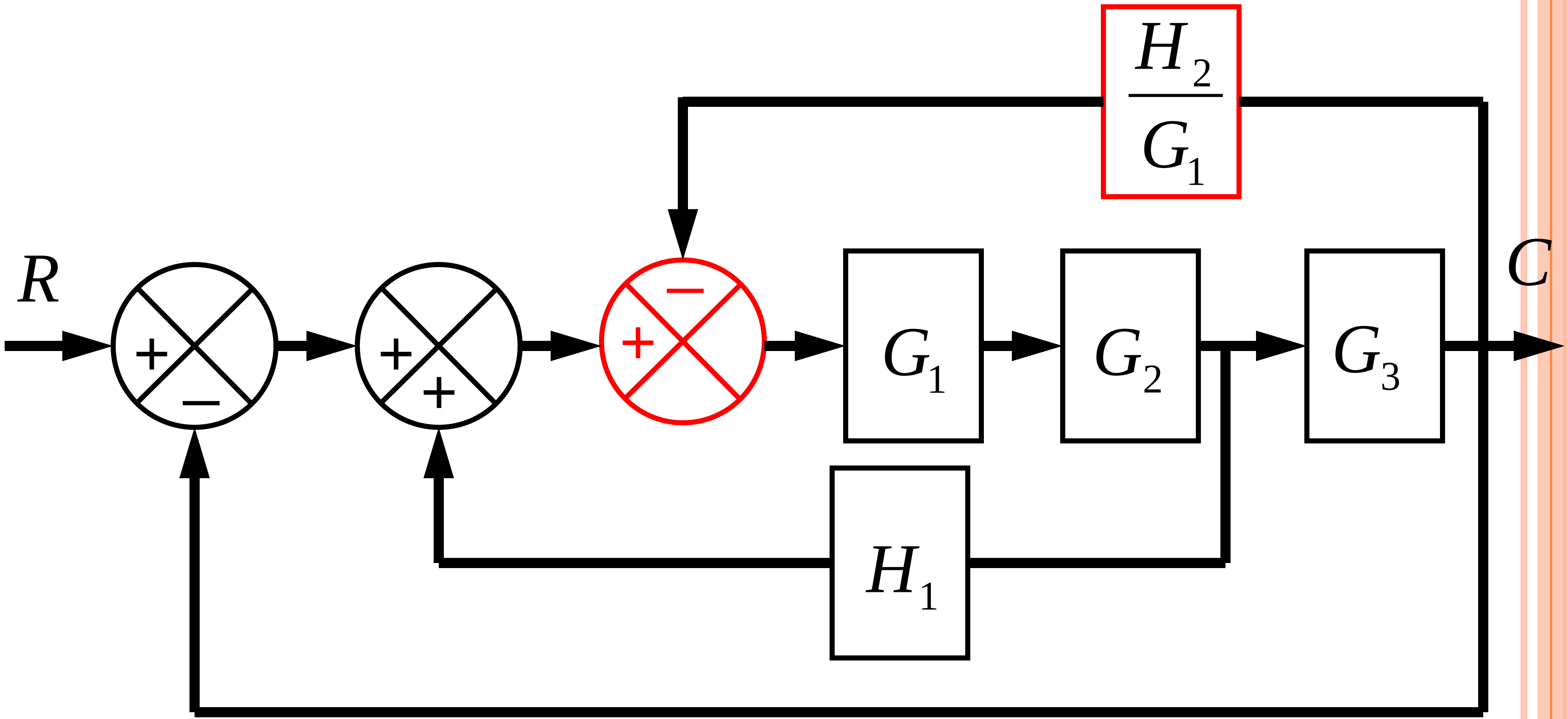
the closed-loop transfer function $C(s)/R(s)$ is obtained as

$$\frac{C(s)}{R(s)} = \frac{G_1G_2G_3G_4}{1 + G_1G_2H_1 + G_3G_4H_2 - G_2G_3H_3 + G_1G_2G_3G_4H_1H_2}$$

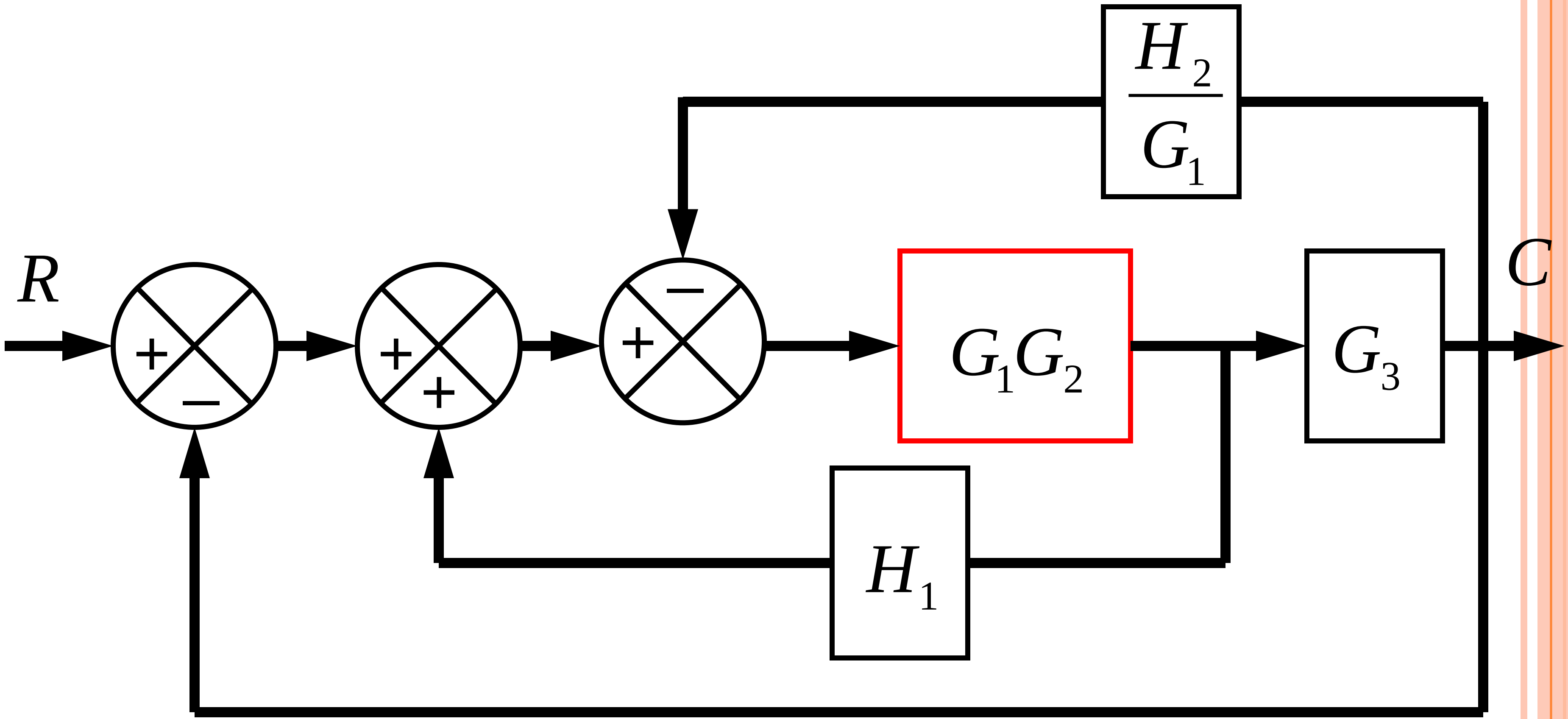
Example-12: Reduce the Block Diagram.



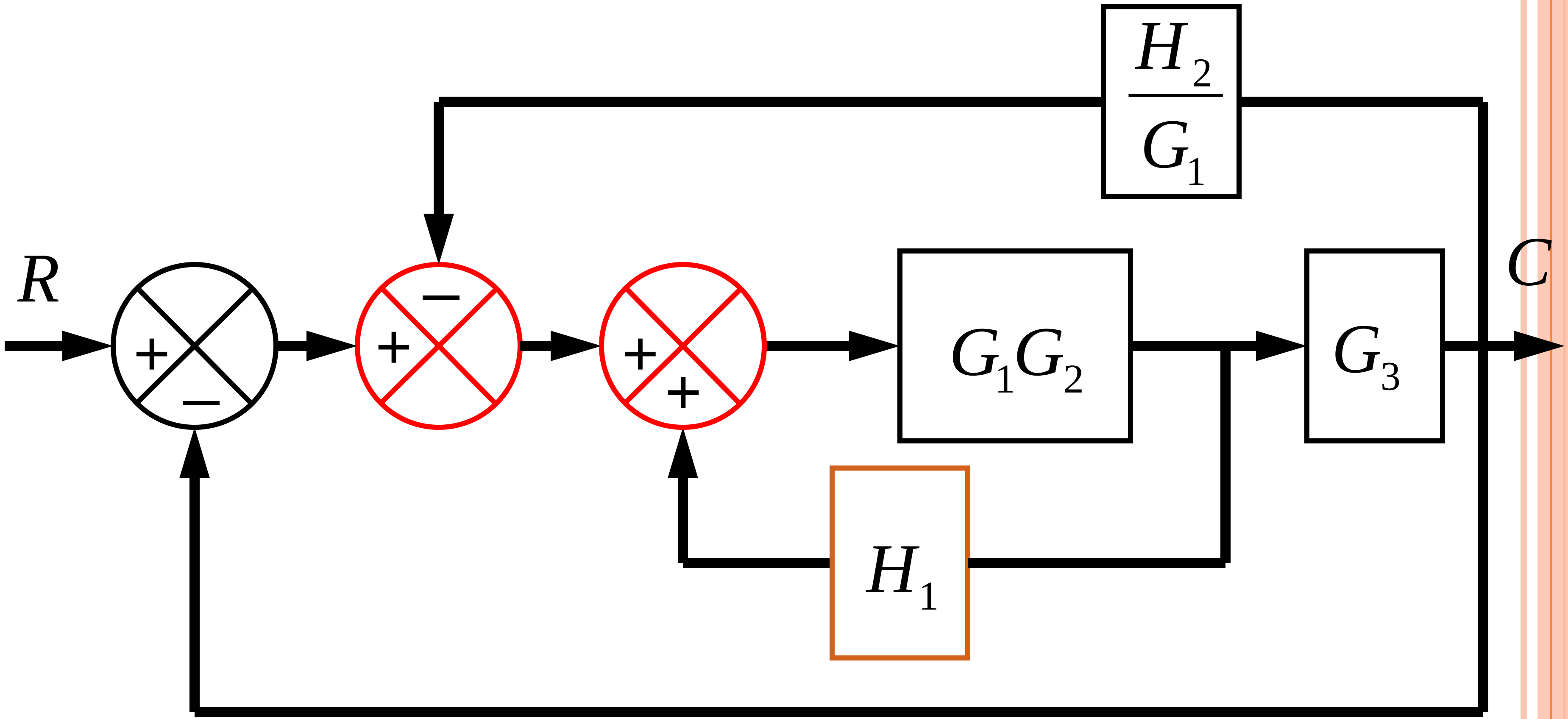
Example-12:



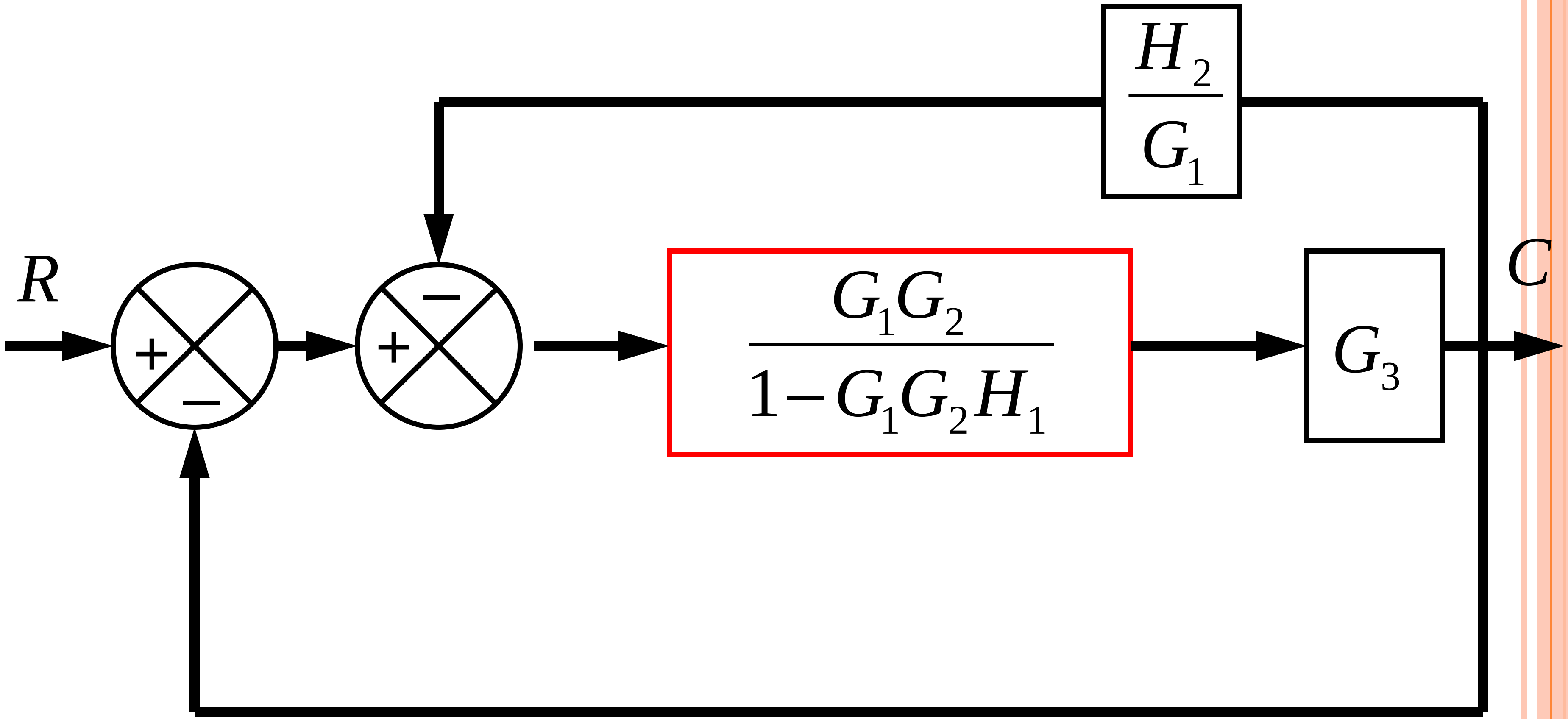
EXAMPLE-12:



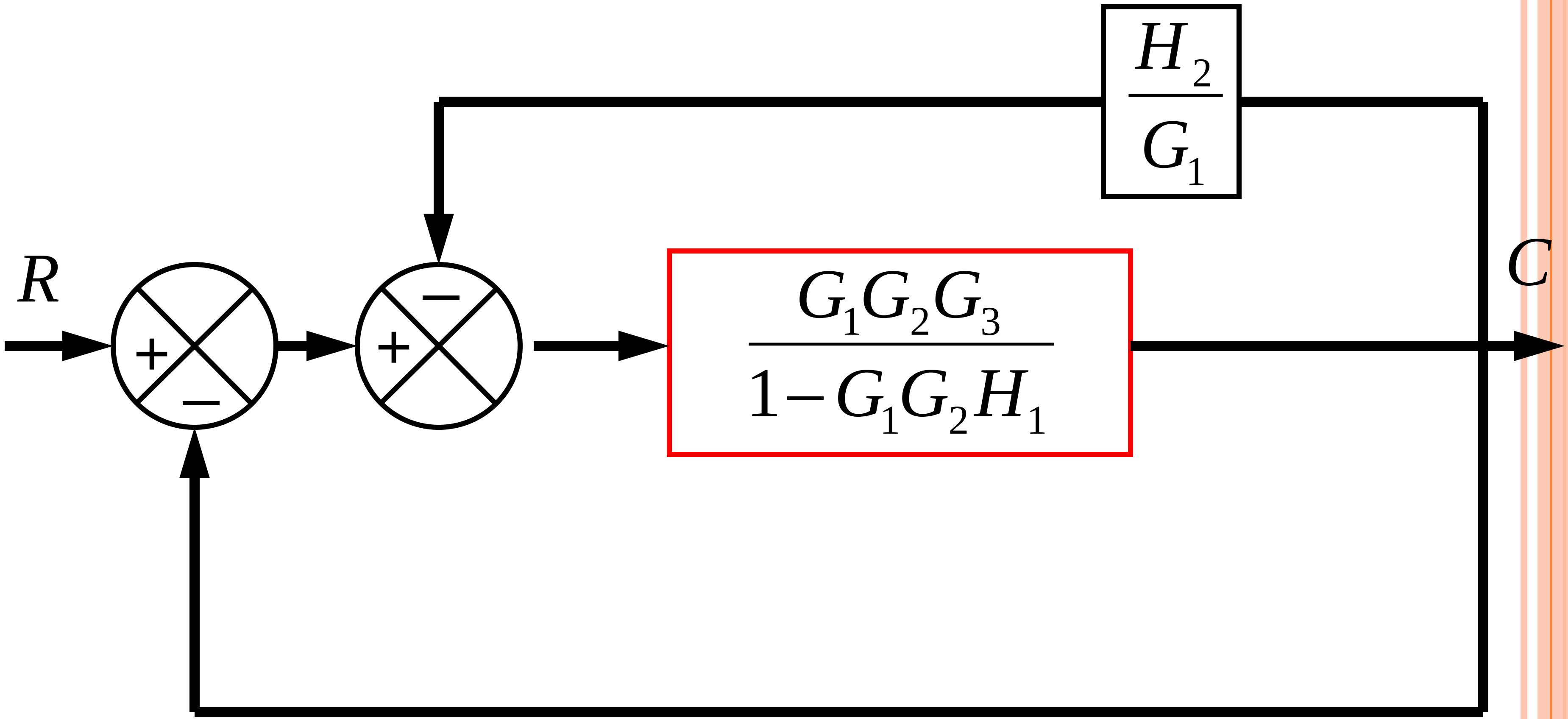
EXAMPLE-12:



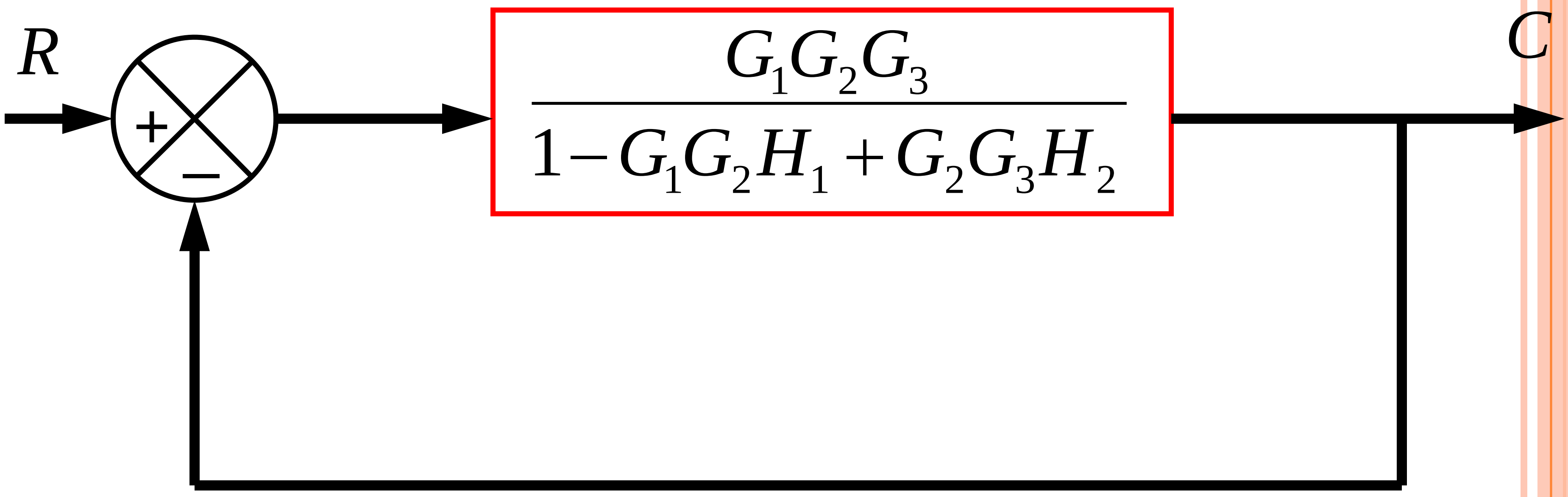
Example-12:



EXAMPLE-12:



Example-12:



EXAMPLE-12:

R

$$\frac{G_1G_2G_3}{1-G_1G_2H_1+G_2G_3H_2+G_1G_2G_3}$$

C