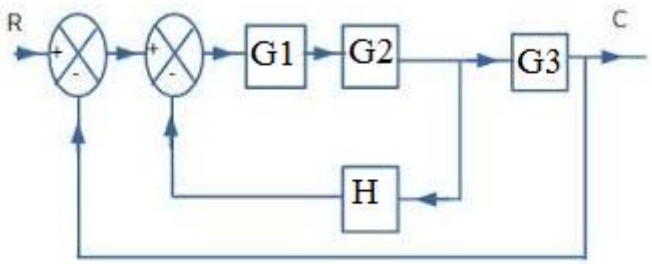
Block Diagram Reduction

(Tutorial)

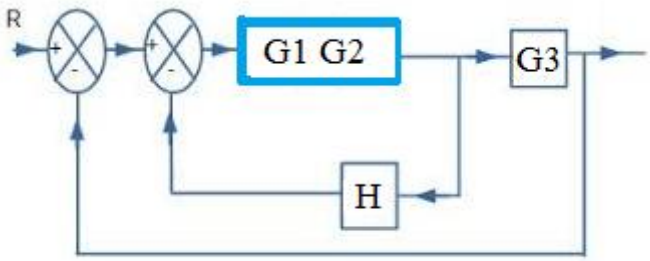
Example 1: simplify the diagram below



Answer

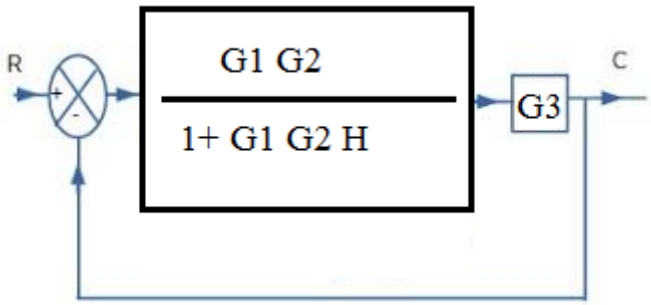
Step 1 – Use Rule 1 for blocks G_1 and G_2.

The modified block diagram is shown in the following figure.

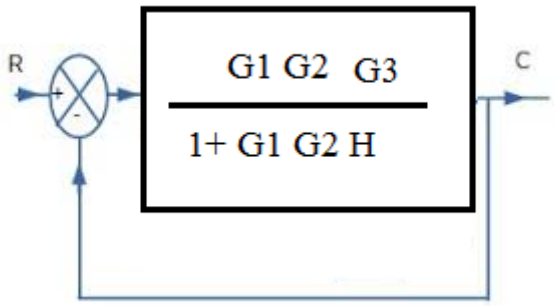


Step 2 – Use **Rule 3** for feedback H with blocks

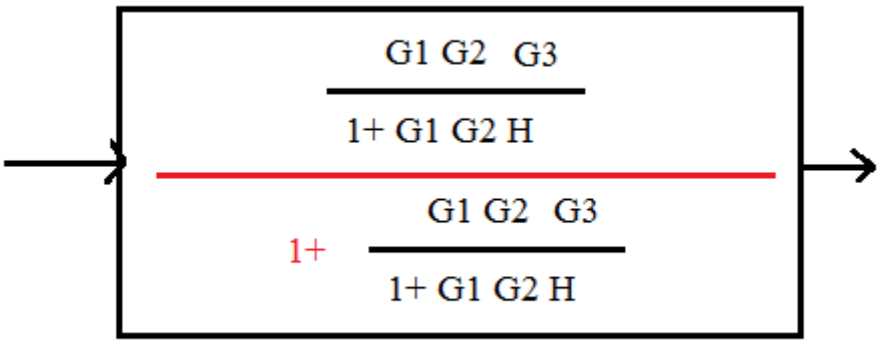
The modified block diagram is shown in the following figure.



Step 3– Use Rule 1 for blocks with G3

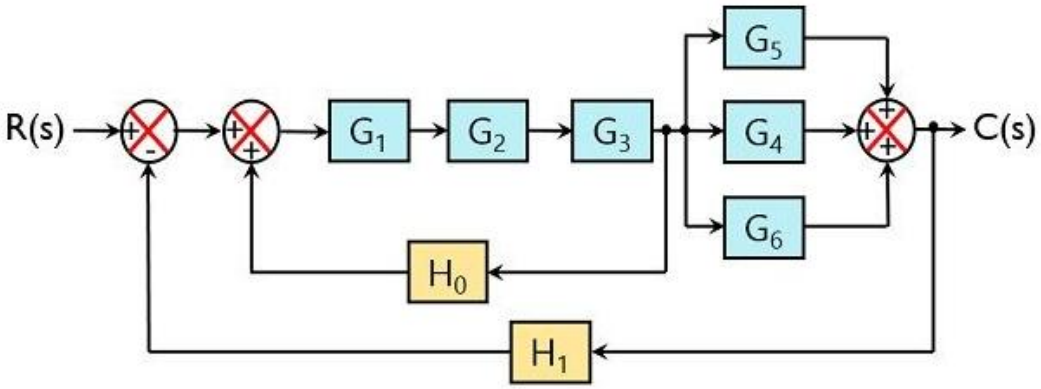


Step 4– Use **Rule 3** for feedback line with blocks



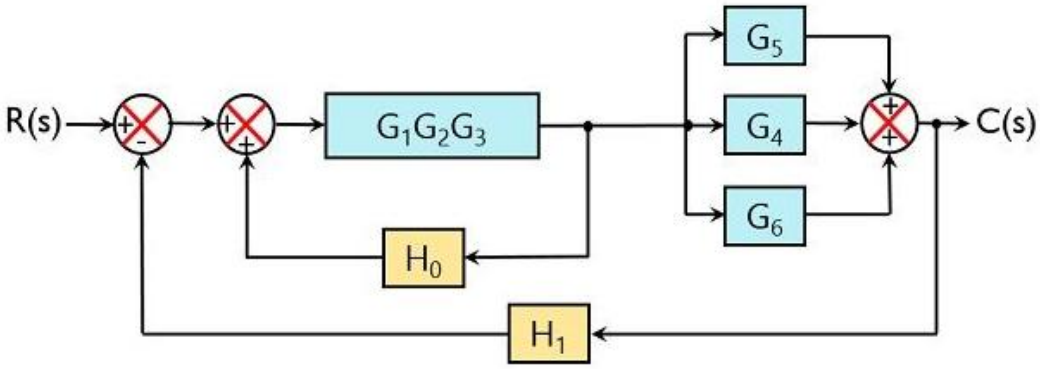
Example 2: Consider the block diagram shown in the following figure.

simplify the diagram below

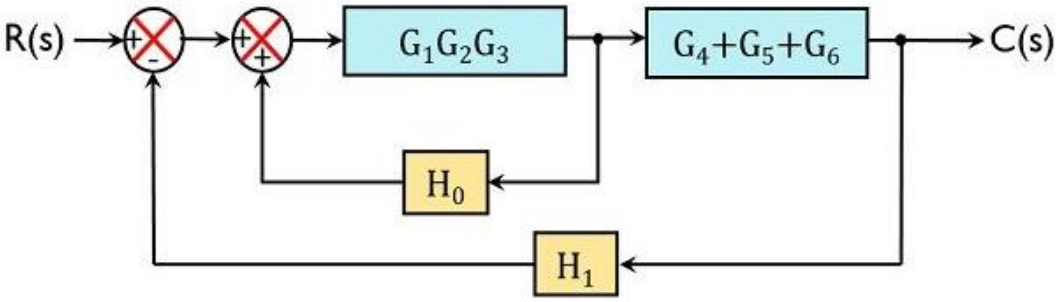


Solution

Step 1 : Use **Rule 1** for blocks G_1 , G_2 , G3.

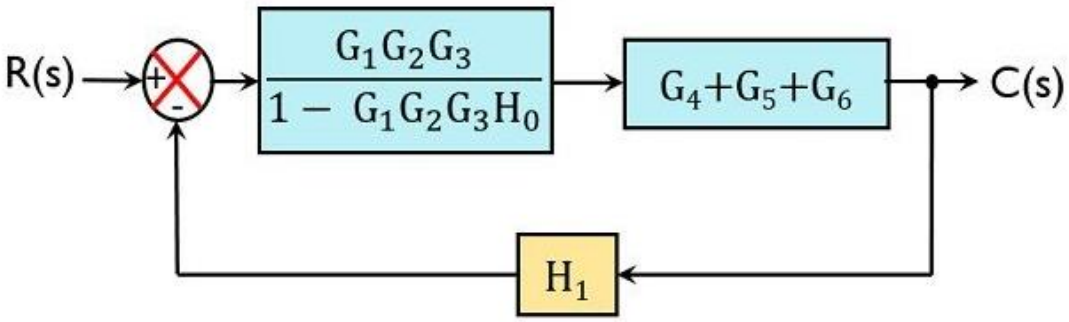


Step 2: Use **Rule 2** for blocks G_4 , G_5 , G6.



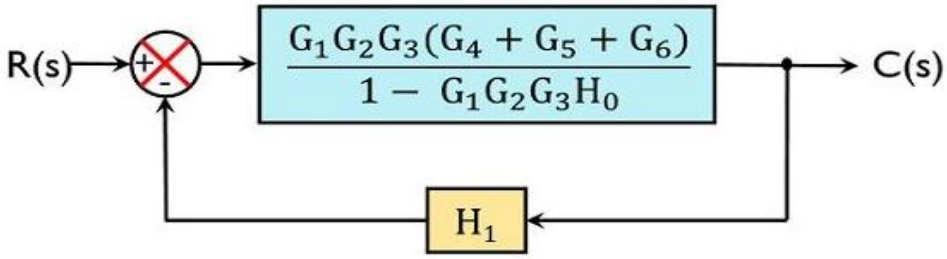
Step 2: Use **Rule 3** for feedback H_0 with blocks

The modified block diagram is shown in the following figure.



Step 3: Use **Rule 1**

Now reducing the two blocks in series:



Step 4: Use **Rule 3** for feedback H_1 with blocks

Therefore,

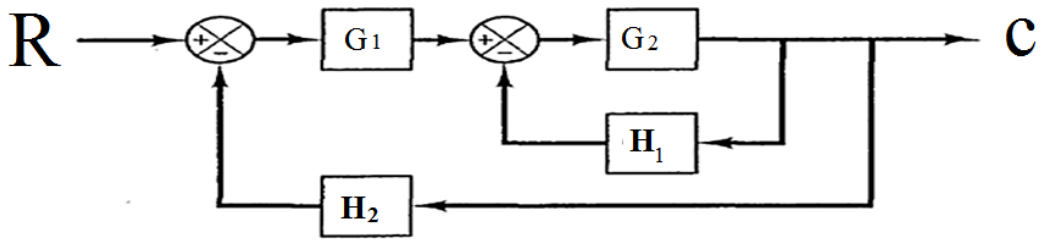
$$\frac{C(s)}{R(s)} = \frac{\frac{G_1G_2G_3(G_4+G_5+G_6)}{1-G_1G_2G_3H_0}}{1+\left[\frac{G_1G_2G_3(G_4+G_5+G_6)}{1-G_1G_2G_3H_0}\right]H_1}$$

On simplifying the equation

$$\frac{C(s)}{R(s)} = \frac{G_1G_2G_3(G_4+G_5+G_6)}{1-G_1G_2G_3H_0+G_1G_2G_3(G_4+G_5+G_6)H_1}$$

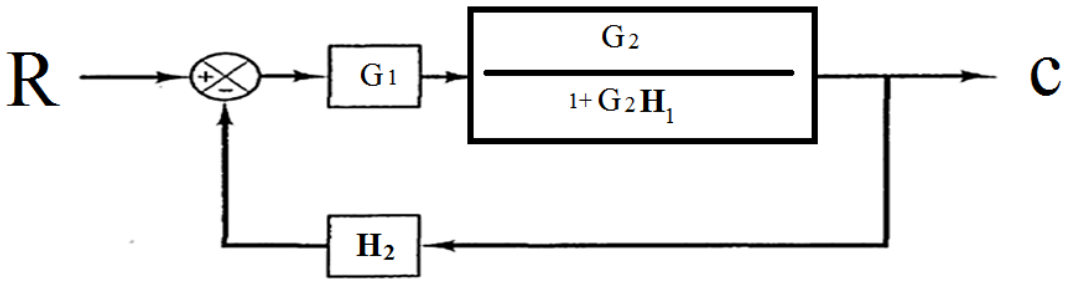
Example 3: Consider the block diagram shown in the following figure.

Find the transfer function.

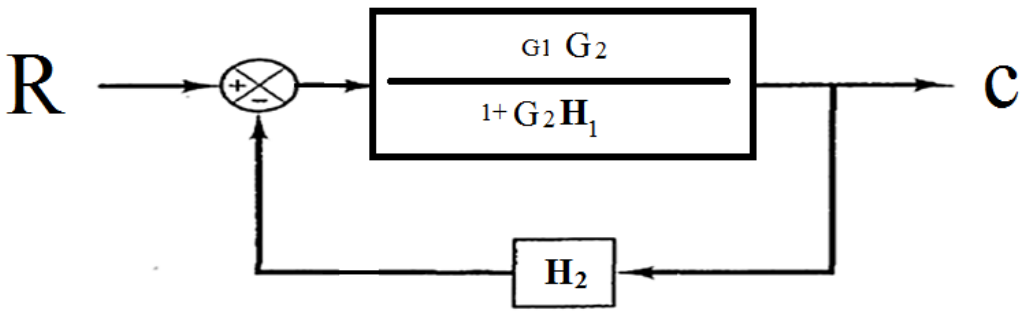


Solution

Step1:



Srep2:



Step3

$$R \longrightarrow \frac{\dfrac{G_1 G_2}{1+G_2H_1}}{1+\left[\dfrac{G_1 G_2}{1+G_2H_1}\right]H_2} \longrightarrow C$$

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Example 4

Simplify the block diagram shown in figure below. Obtain the transfer function relating C(s) and *R(s)*.