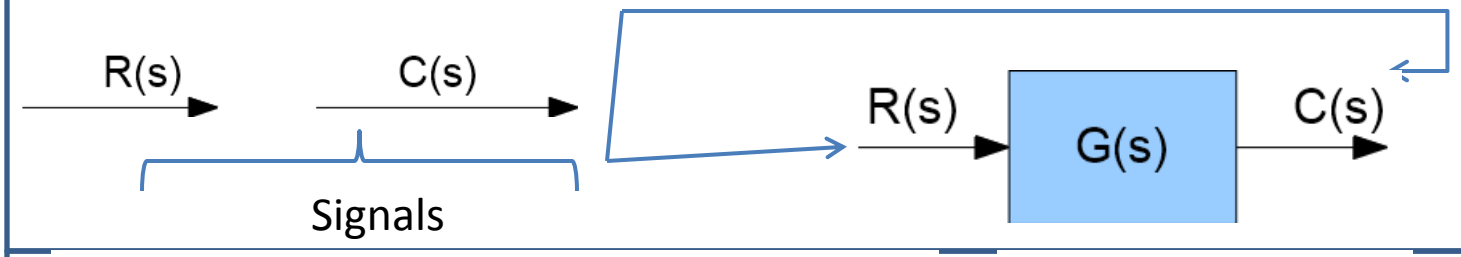
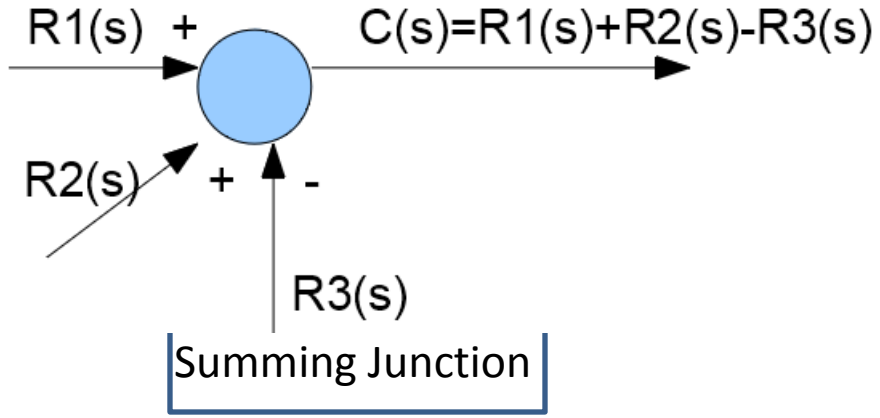
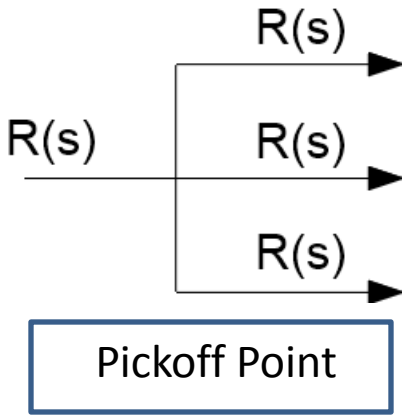
FEEDBACK CONTROL SYSTEMS

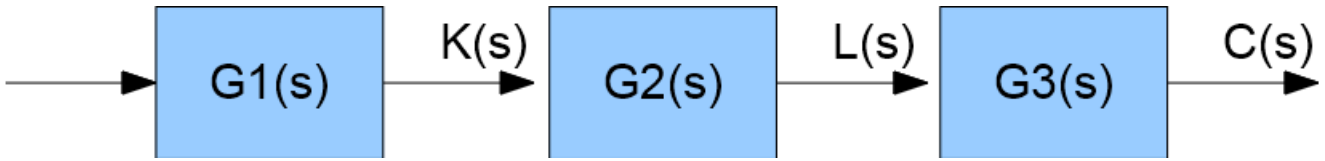
LECTURE NOTES-4/12

Block Diagrams





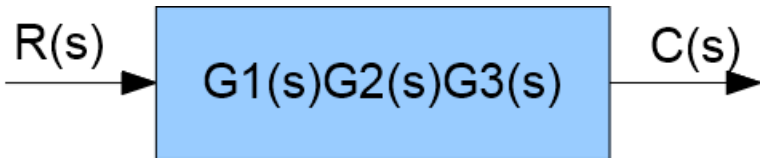


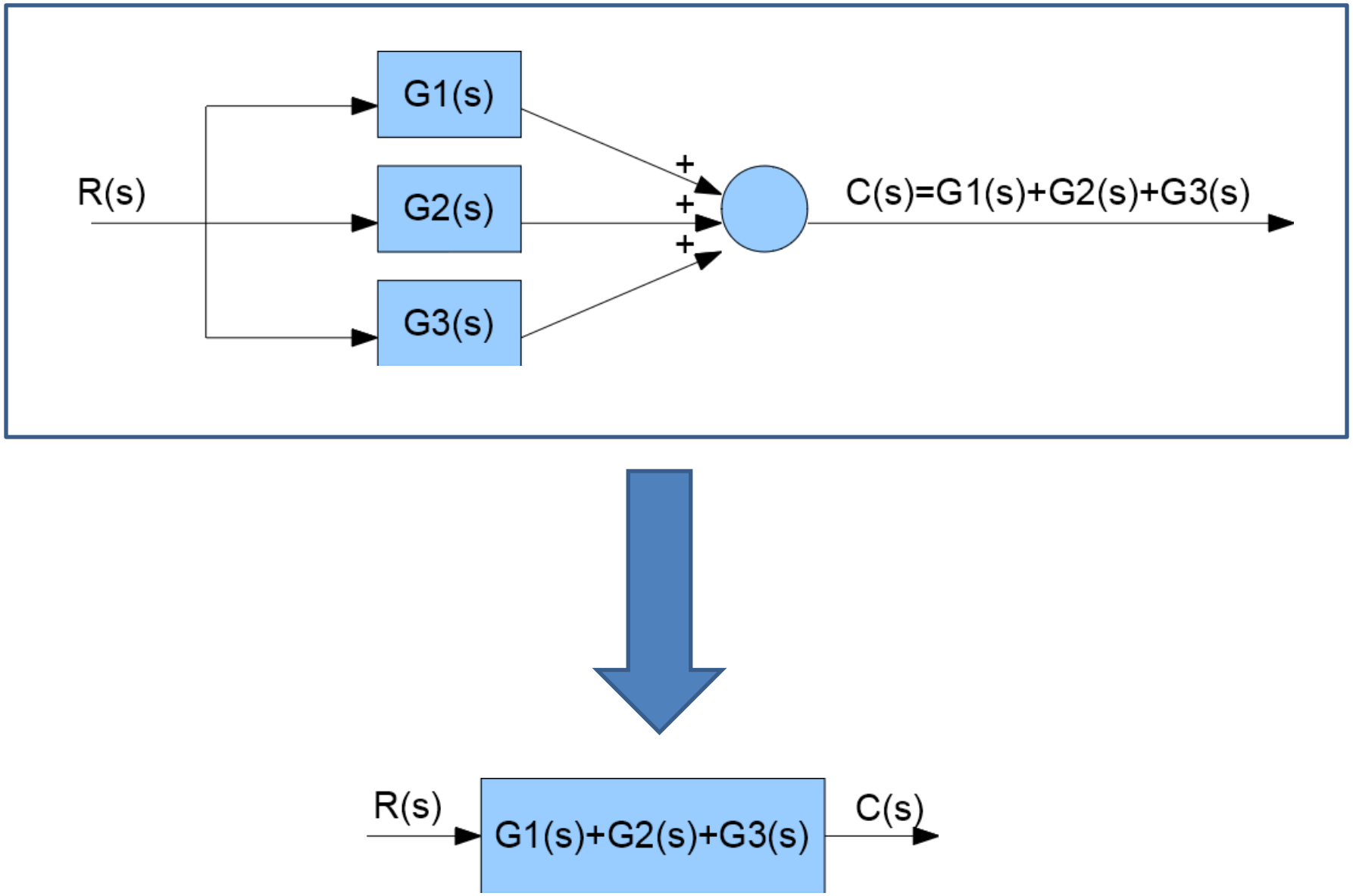


$$K(s) = G_1(s)R(s)$$

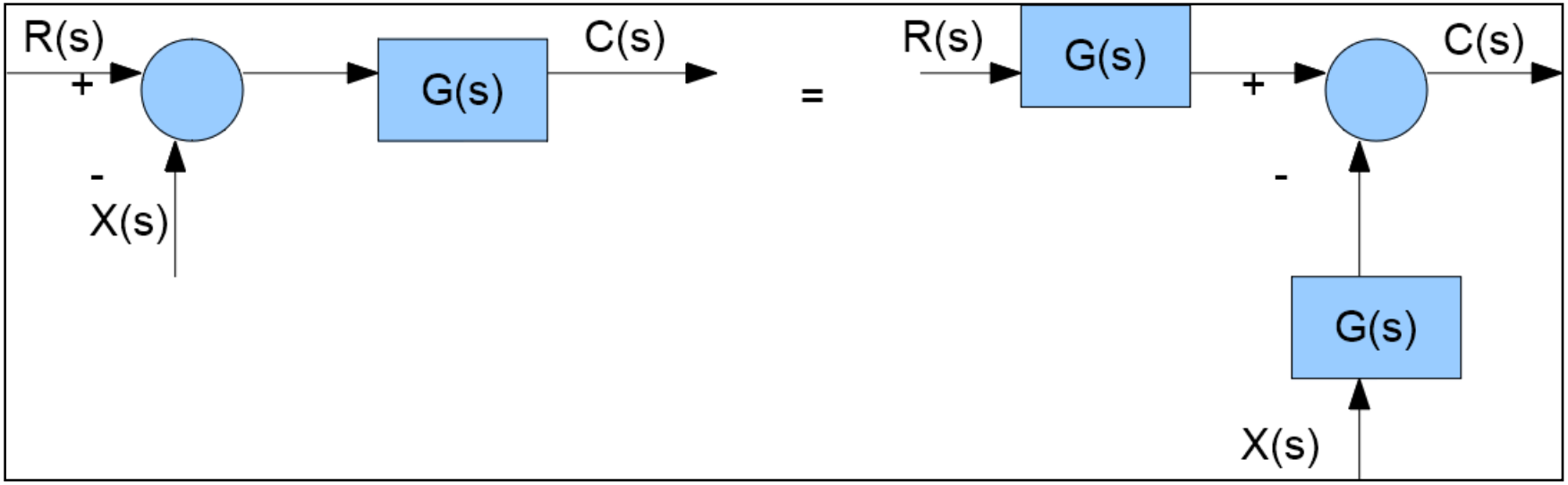
$$L(s) = G_2(s)G_1(s)R(s)$$

$$C(s) = G_3(s)G_2(s)G_1(s)R(s)$$

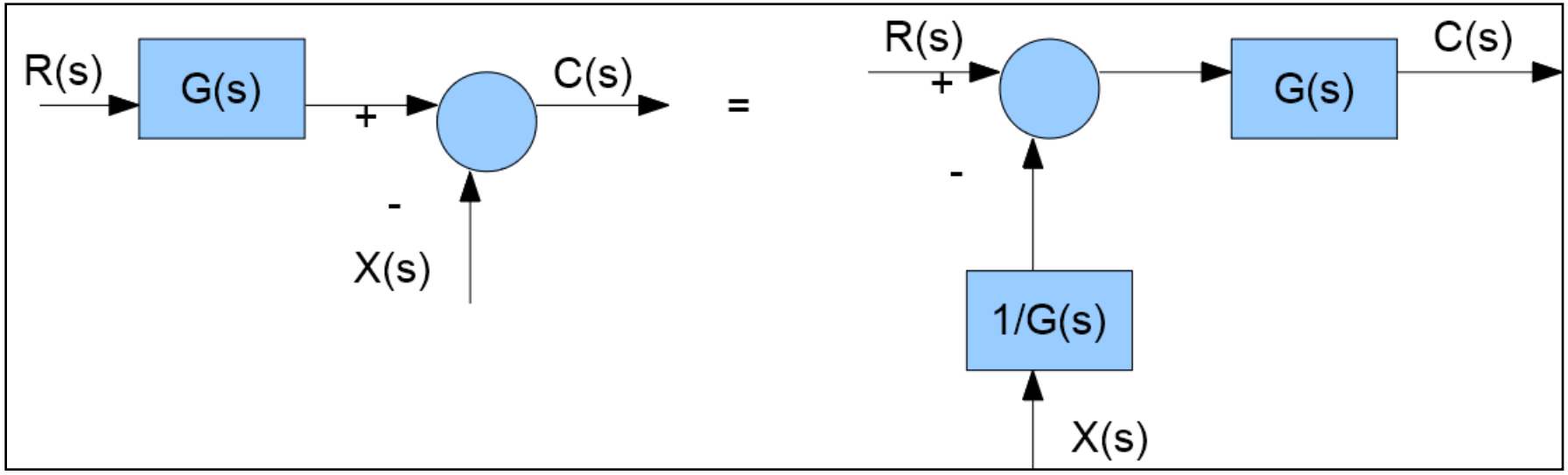



G1(s)
G2(s)
G3(s)
R(s)
+
+
+
C(s)=G1(s)+G2(s)+G3(s)
R(s)
G1(s)+G2(s)+G3(s)
C(s)

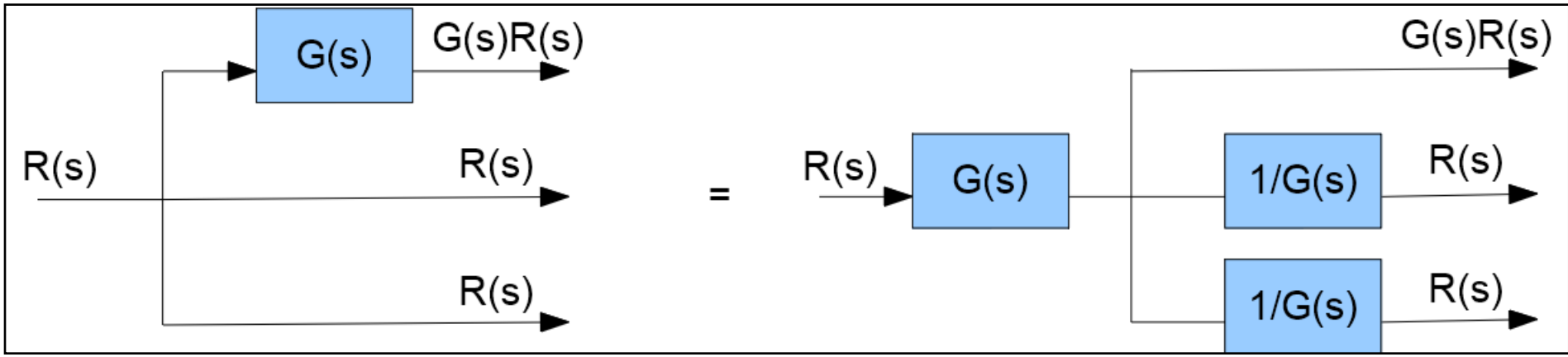
(A)



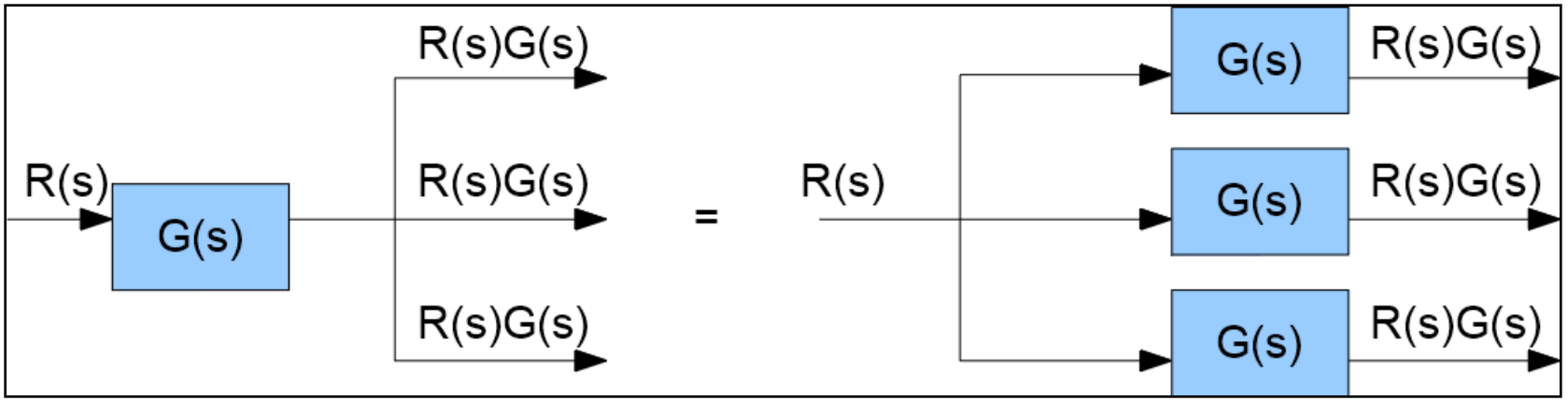
(B)

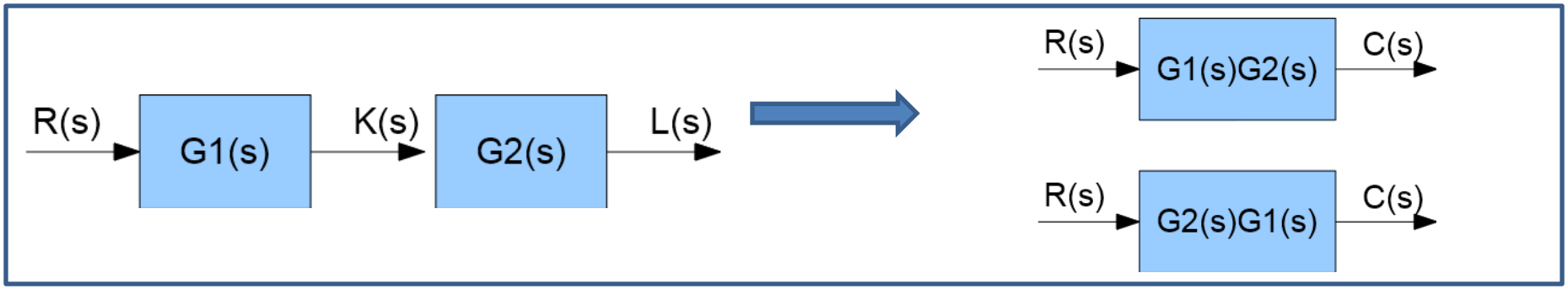


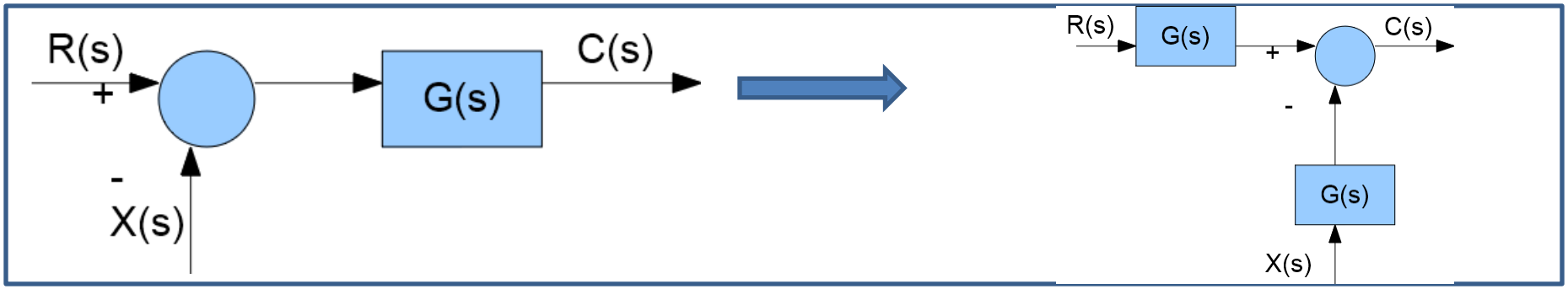
(C)

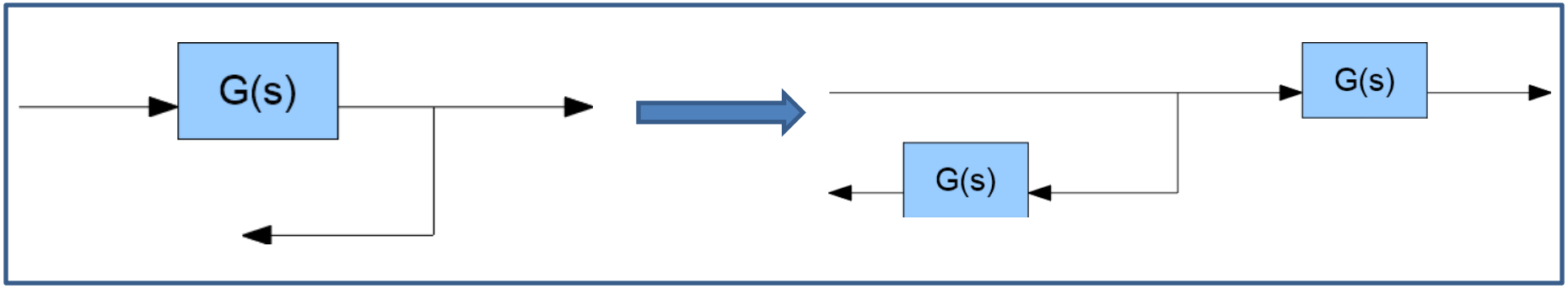

G(s)
G(s)R(s)
R(s)
R(s)
R(s)
=
R(s)
G(s)
G(s)R(s)
1/G(s)
R(s)
1/G(s)
R(s)

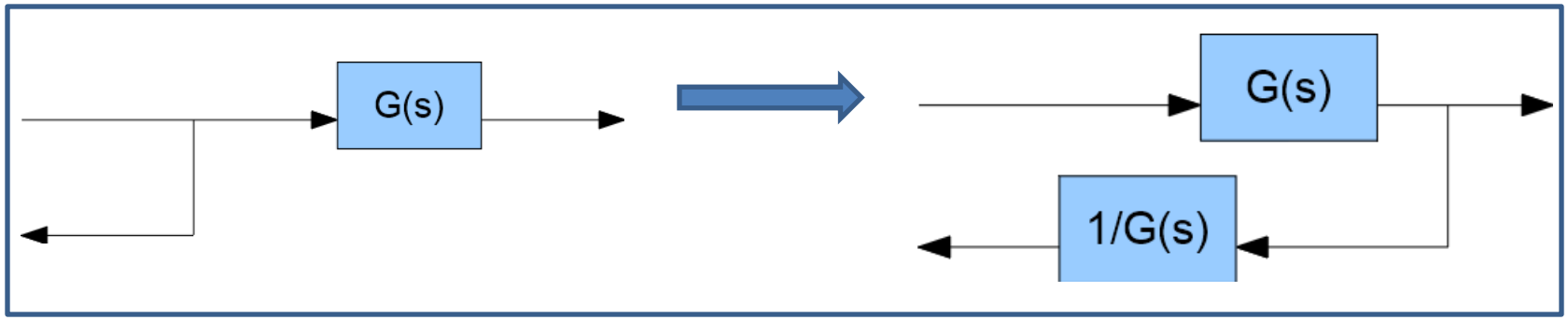
(D)

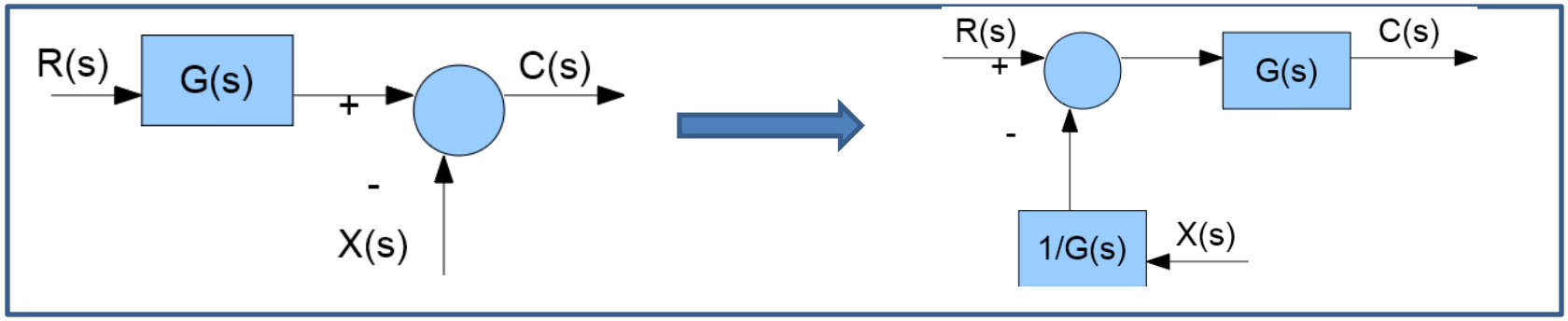

R(s)
G(s)
R(s)G(s)
R(s)G(s)
R(s)G(s)
=
R(s)
G(s)
G(s)
G(s)
R(s)G(s)
R(s)G(s)
R(s)G(s)

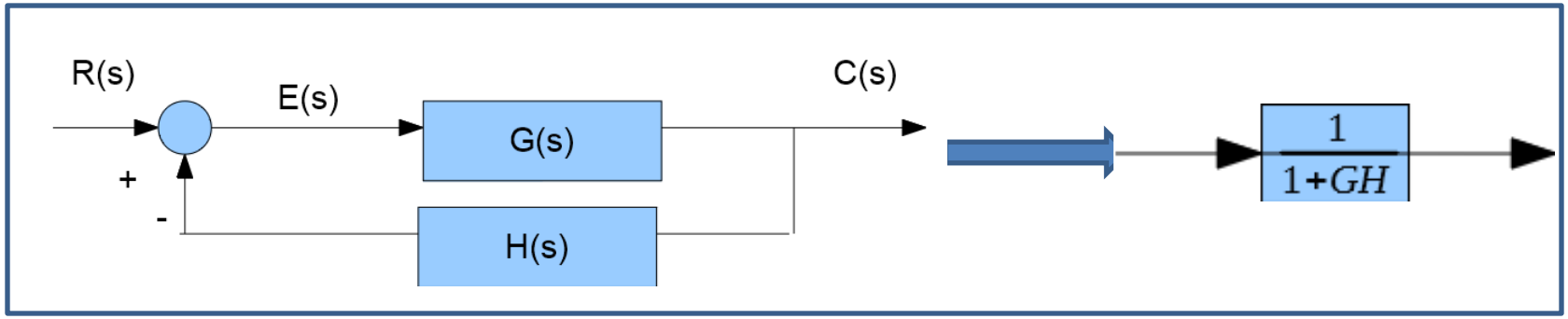

R(s)
G1(s)
K(s)
G2(s)
L(s)
R(s)
G1(s)G2(s)
C(s)
R(s)
G2(s)G1(s)
C(s)

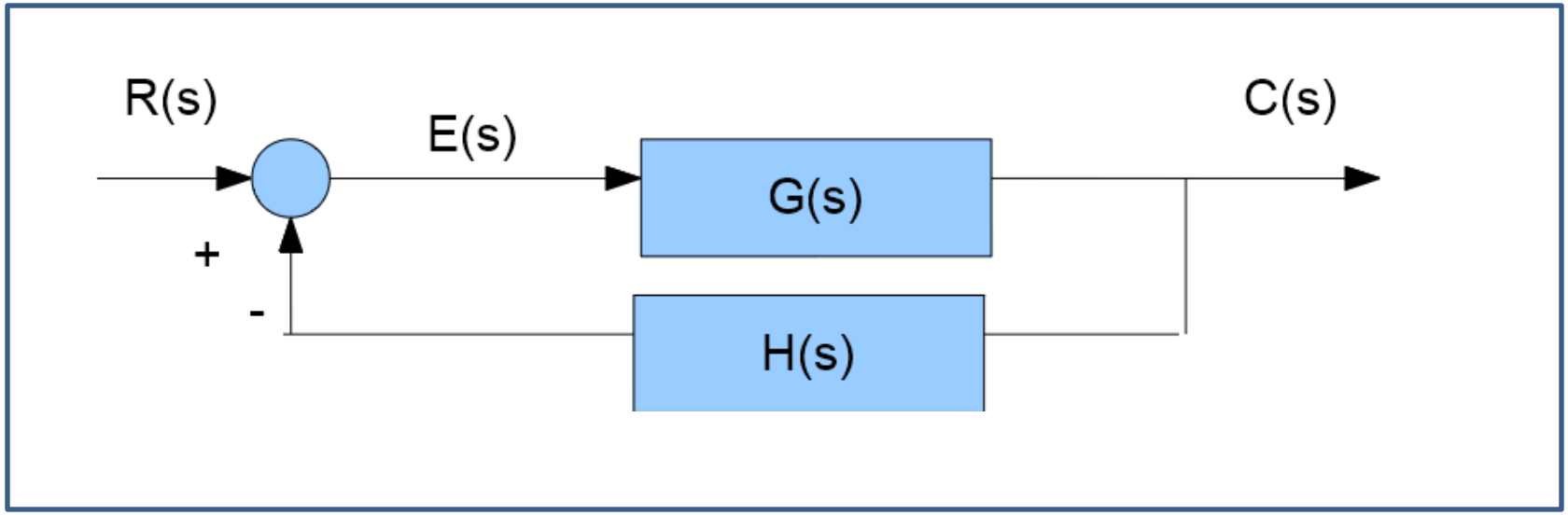

R(s)
+
-
X(s)
G(s)
C(s)
R(s)
G(s)
+
C(s)
-
G(s)
X(s)

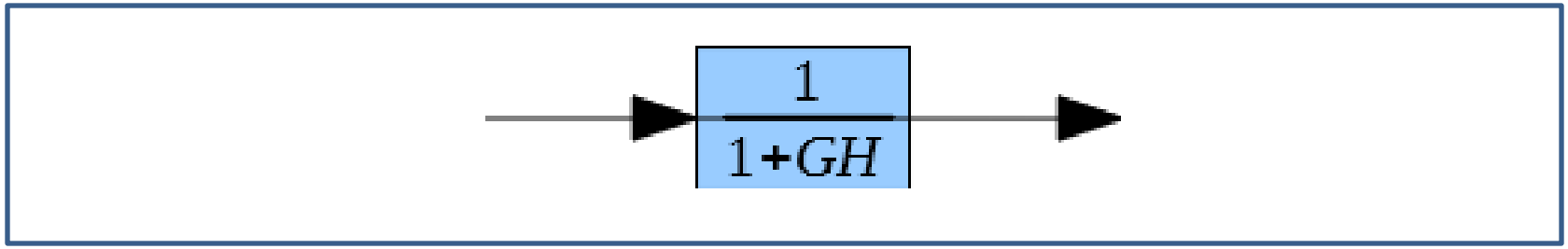

G(s)
G(s)
G(s)


G(s)
G(s)
1/G(s)


R(s)
G(s)
C(s)
+
-
X(s)
R(s)
+
-
G(s)
C(s)
1/G(s)
X(s)

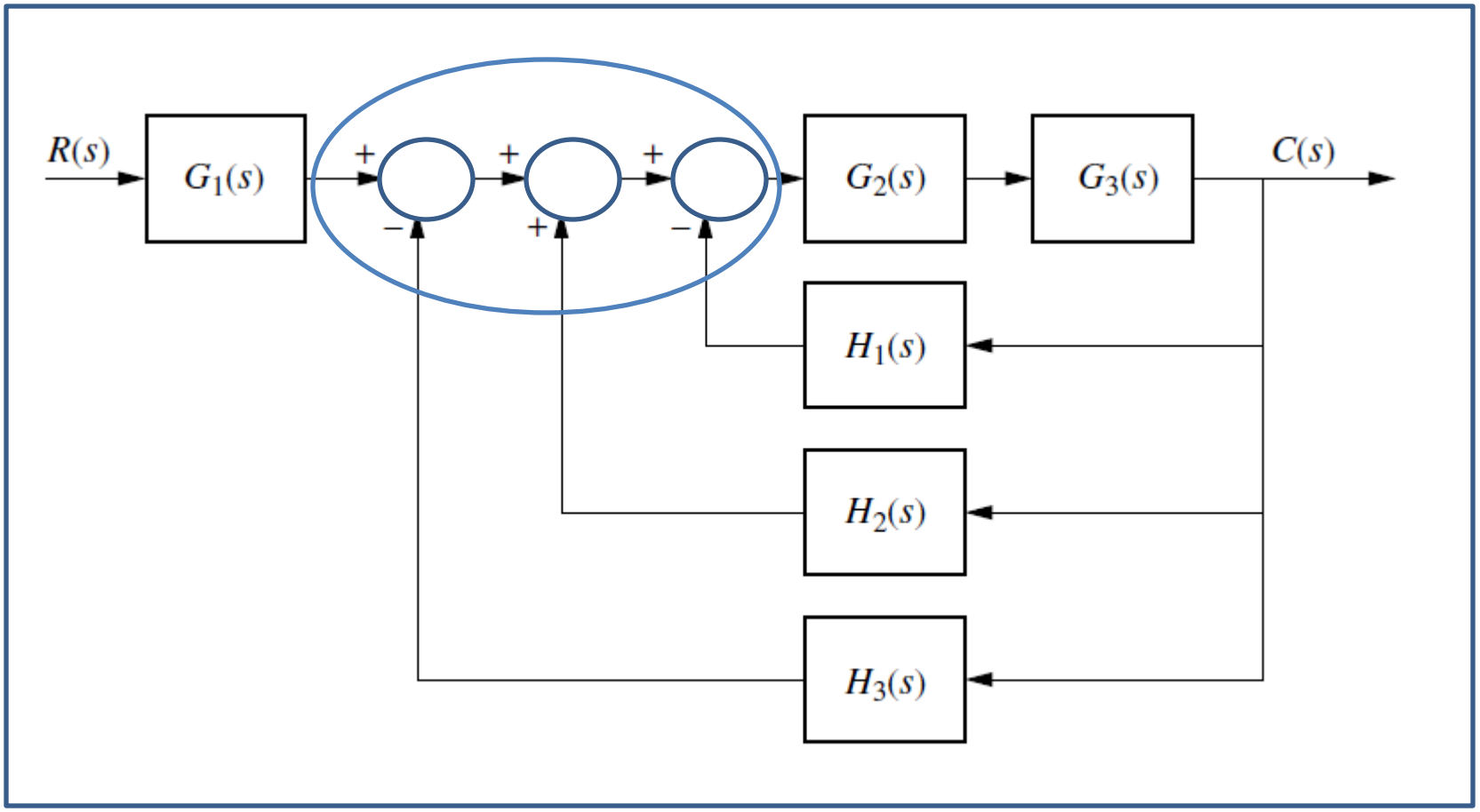

R(s)
E(s)
G(s)
C(s)
+
-
H(s)
1
1+GH

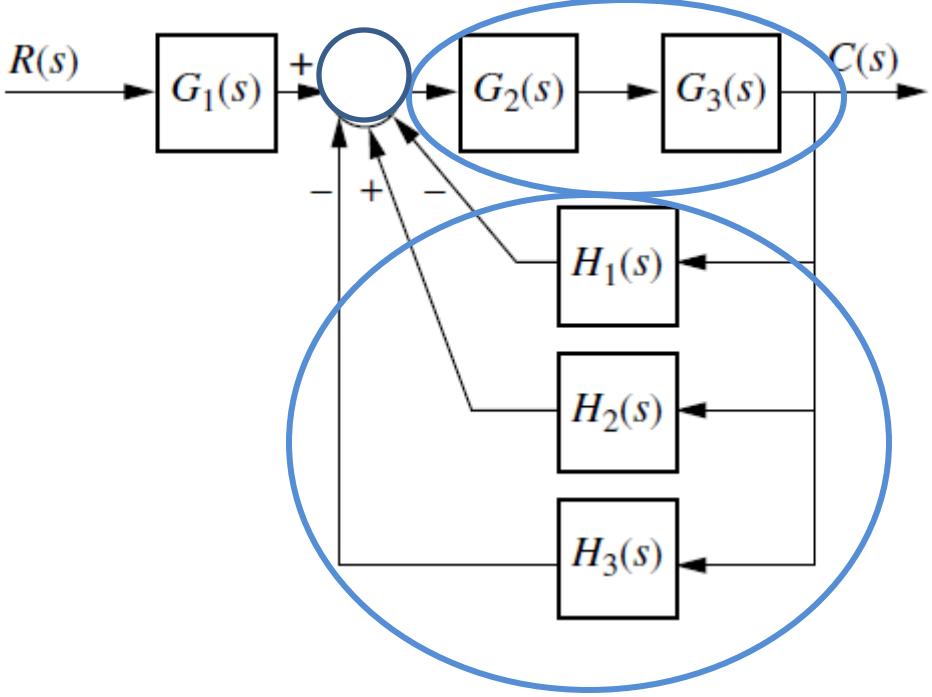

R(s)
E(s)
C(s)
G(s)
H(s)
+
-


$\frac{1}{1+GH}$

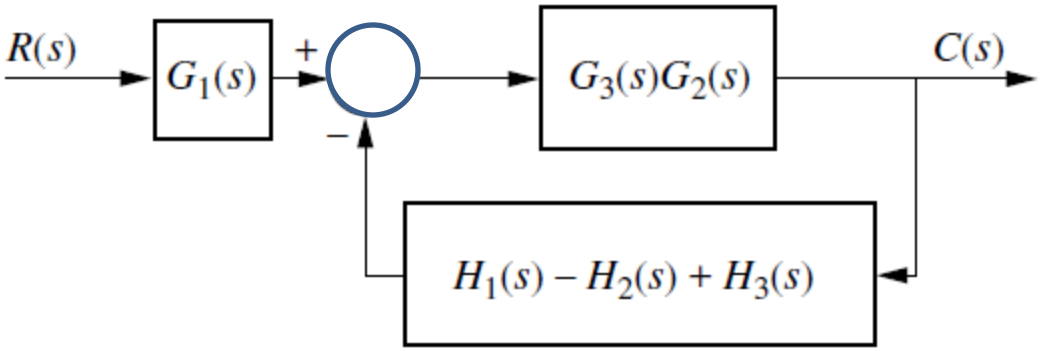
Example:

Reduce the block diagram to a simple transfer function





(1)

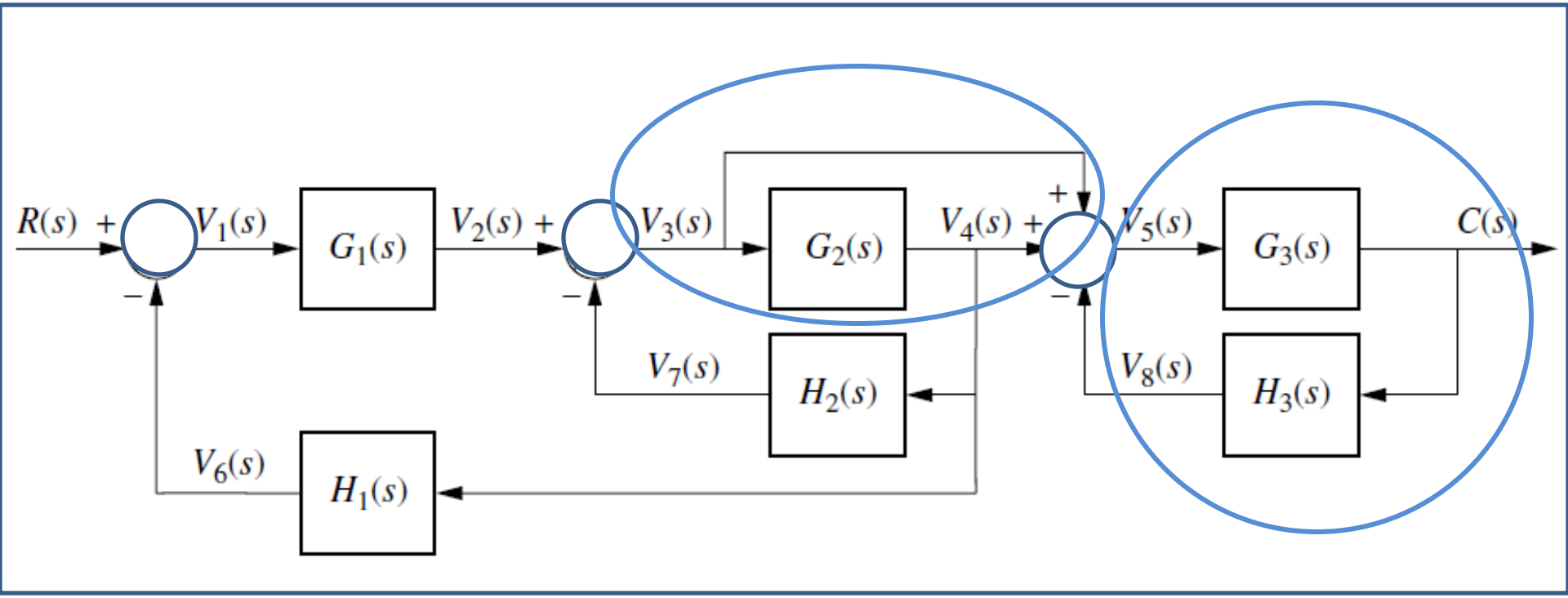


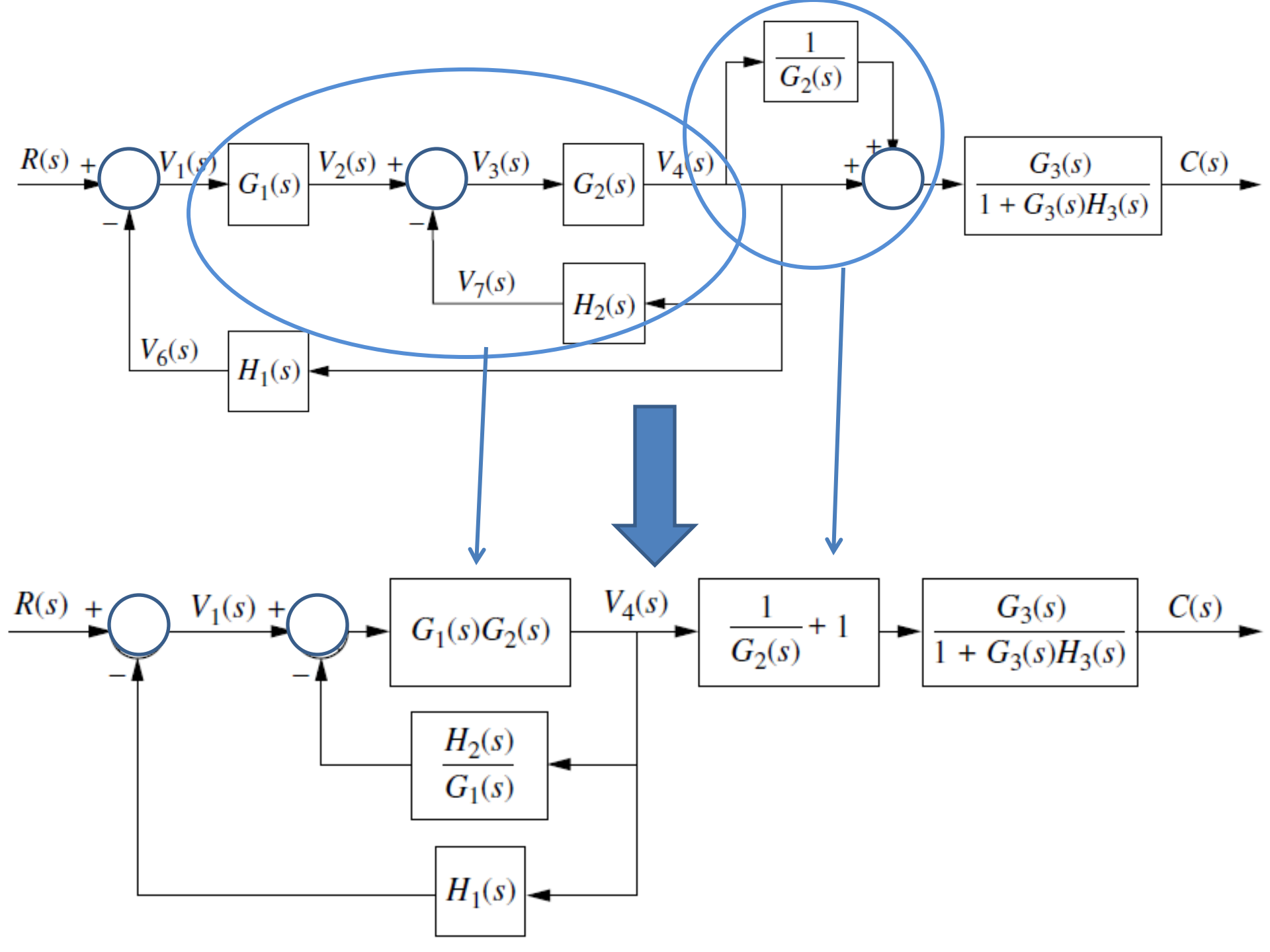
(2)

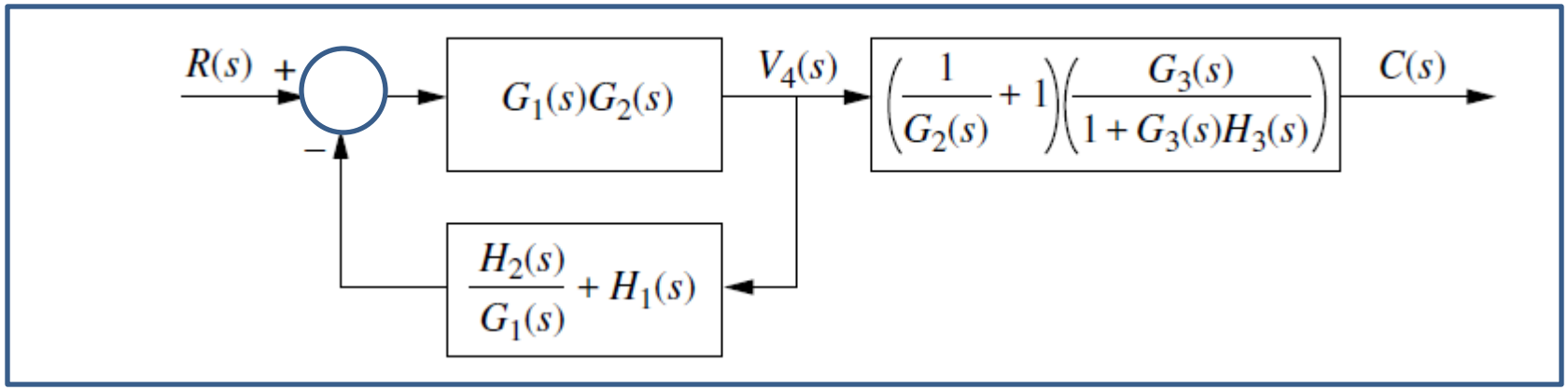
$$R(s) \quad \frac{G_3(s)G_2(s)G_1(s)}{1 + G_3(s)G_2(s)[H_1(s) - H_2(s) + H_3(s)]} \quad C(s)$$

Example:

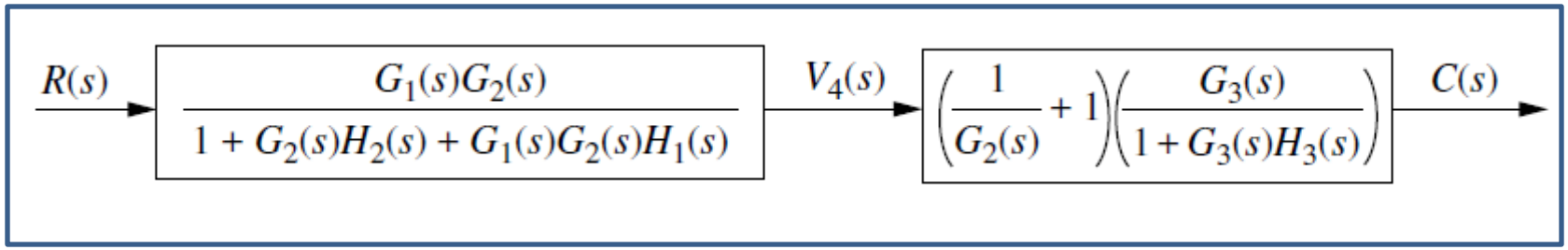
Reduce the block diagram to a simple transfer function



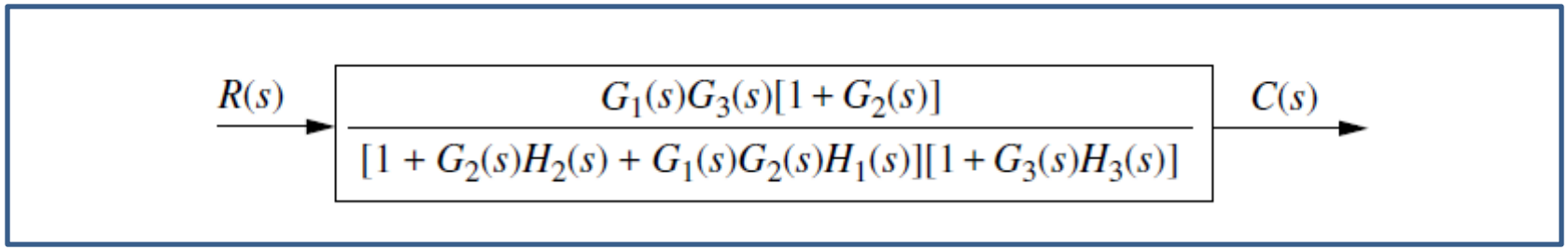

R(s)
V1(s)
G1(s)
V2(s)
V3(s)
G2(s)
V4(s)
1/G2(s)
G3(s)/(1 + G3(s)H3(s))
C(s)
V7(s)
H2(s)
V6(s)
H1(s)
R(s)
V1(s)
G1(s)G2(s)
V4(s)
1/G2(s) + 1
G3(s)/(1 + G3(s)H3(s))
C(s)
H2(s)/G1(s)
H1(s)


R(s)
+
−
$G_1(s)G_2(s)$
$V_4(s)$
$\left(\frac{1}{G_2(s)}+1\right)\left(\frac{G_3(s)}{1+G_3(s)H_3(s)}\right)$
C(s)
$\frac{H_2(s)}{G_1(s)}+H_1(s)$

(1)

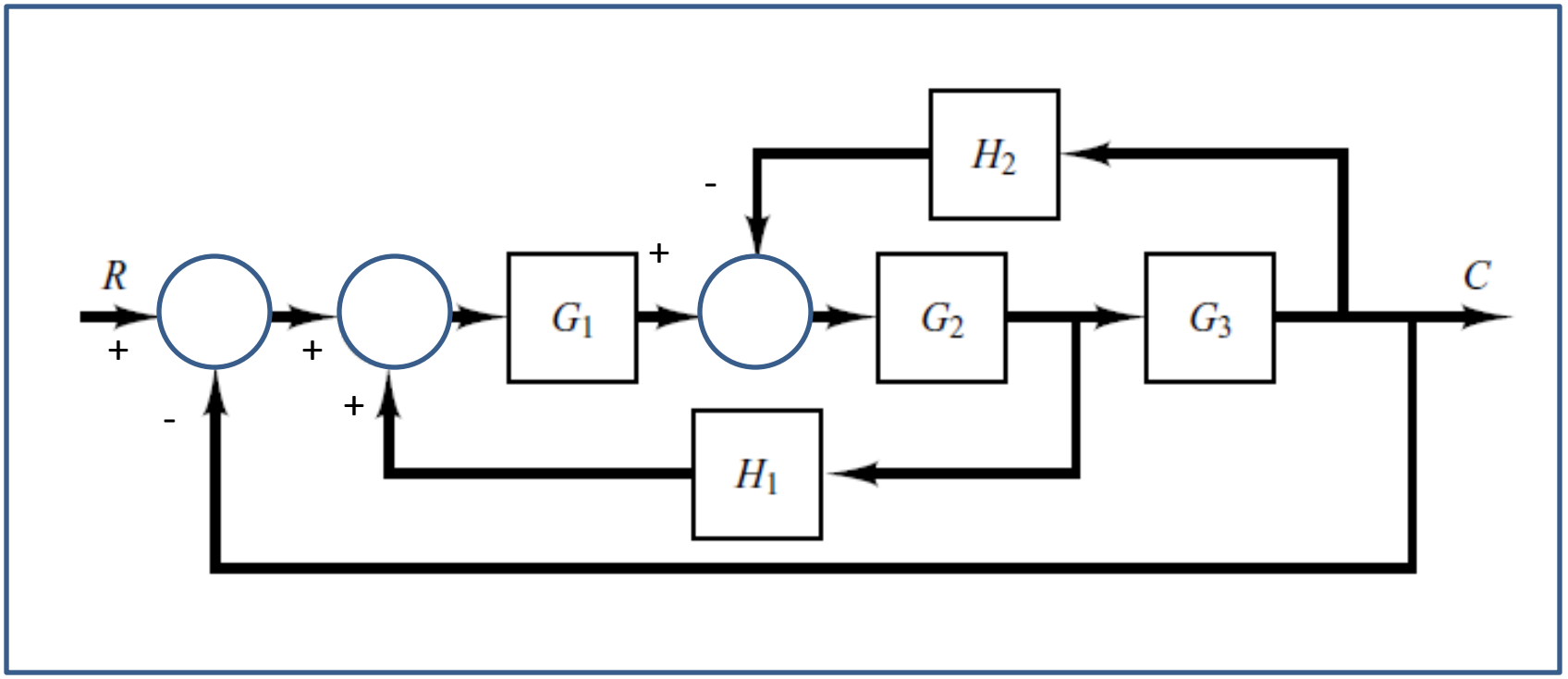

R(s)
$\frac{G_1(s)G_2(s)}{1+G_2(s)H_2(s)+G_1(s)G_2(s)H_1(s)}$
$V_4(s)$
$\left(\frac{1}{G_2(s)}+1\right)\left(\frac{G_3(s)}{1+G_3(s)H_3(s)}\right)$
C(s)

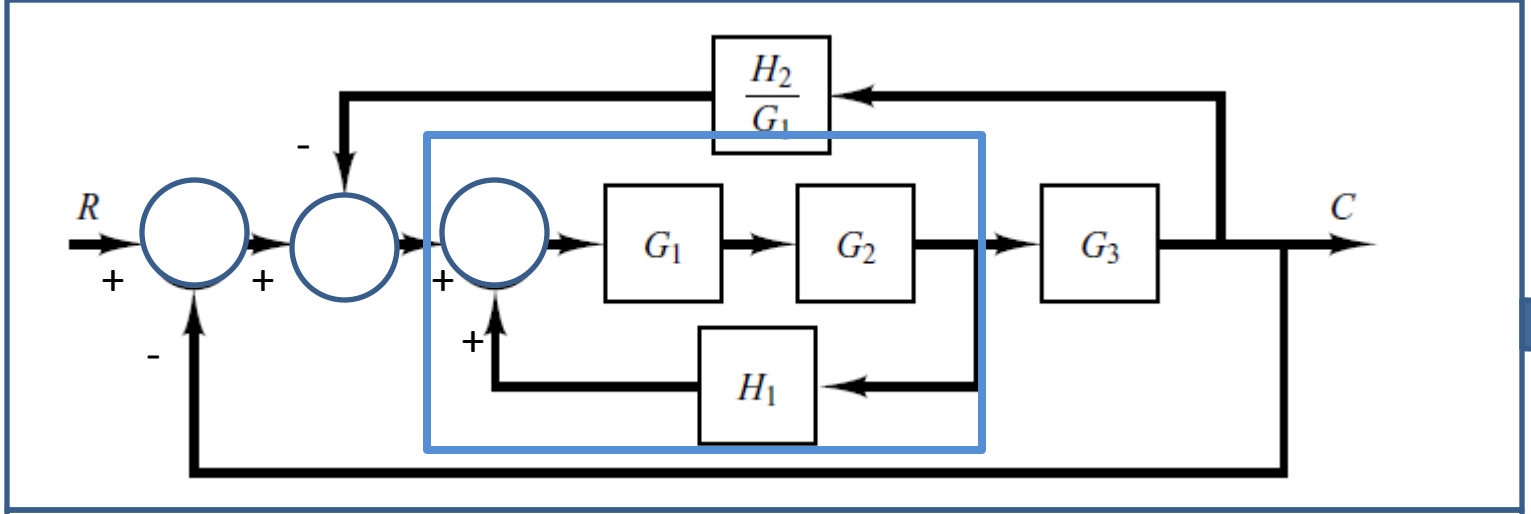
(2)


R(s)
$\frac{G_1(s)G_3(s)[1+G_2(s)]}{[1+G_2(s)H_2(s)+G_1(s)G_2(s)H_1(s)][1+G_3(s)H_3(s)]}$
C(s)

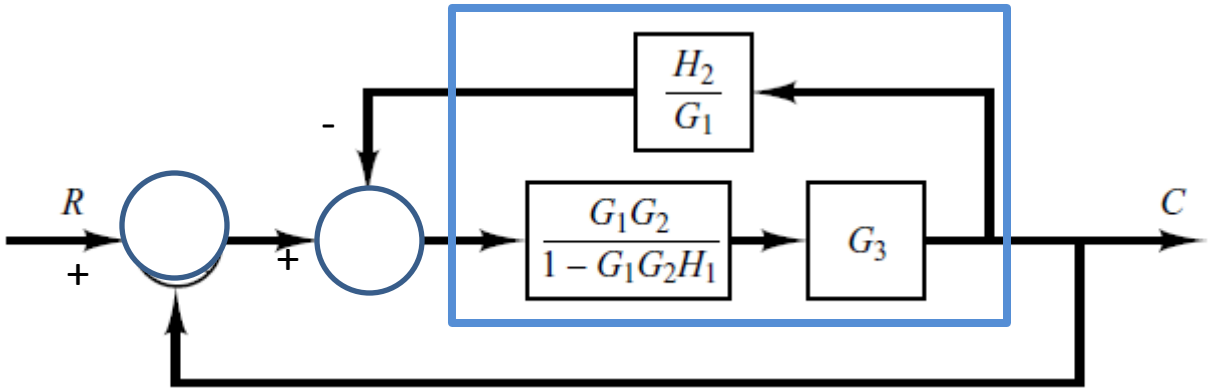
Example:

Reduce the block diagram to a simple transfer function

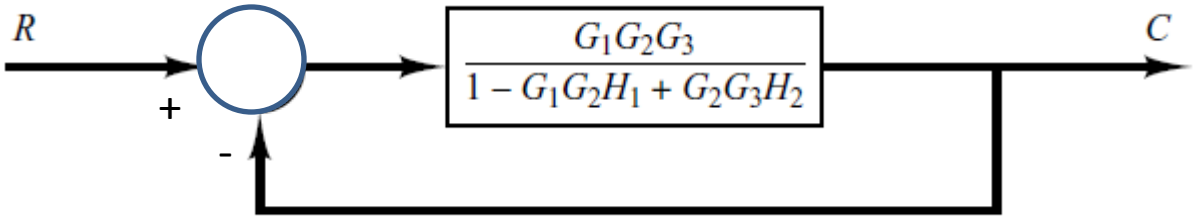



$\frac{H_2}{G_1}$
R
C
G_1
G_2
G_3
H_1
+
+
+
+
-
-

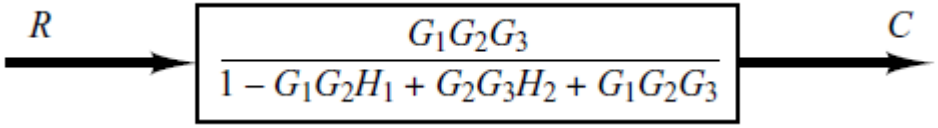
(1)


$\frac{H_2}{G_1}$
R
C
$\frac{G_1G_2}{1-G_1G_2H_1}$
G_3
+
+
-

(2)


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

(3)


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