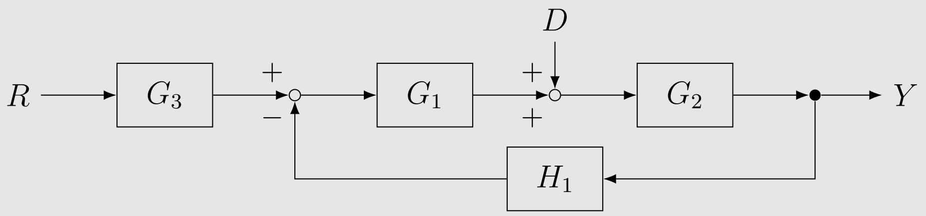
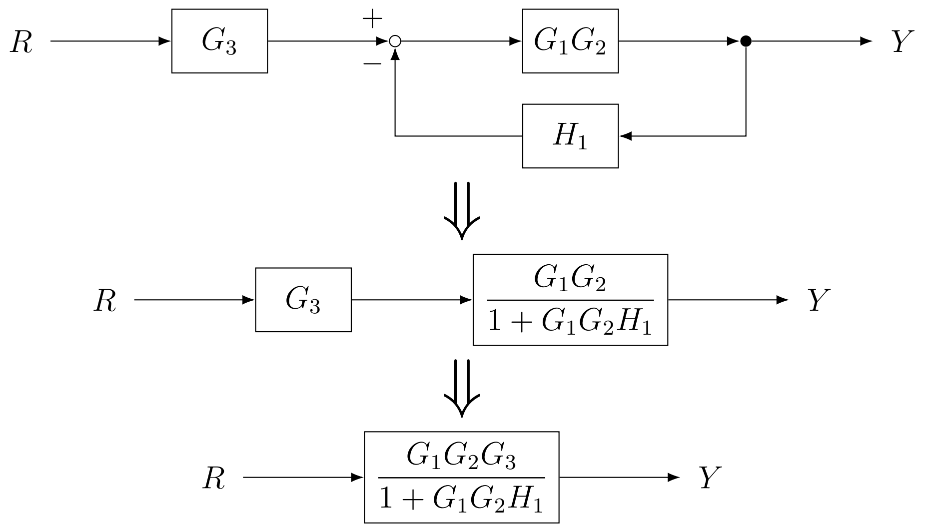
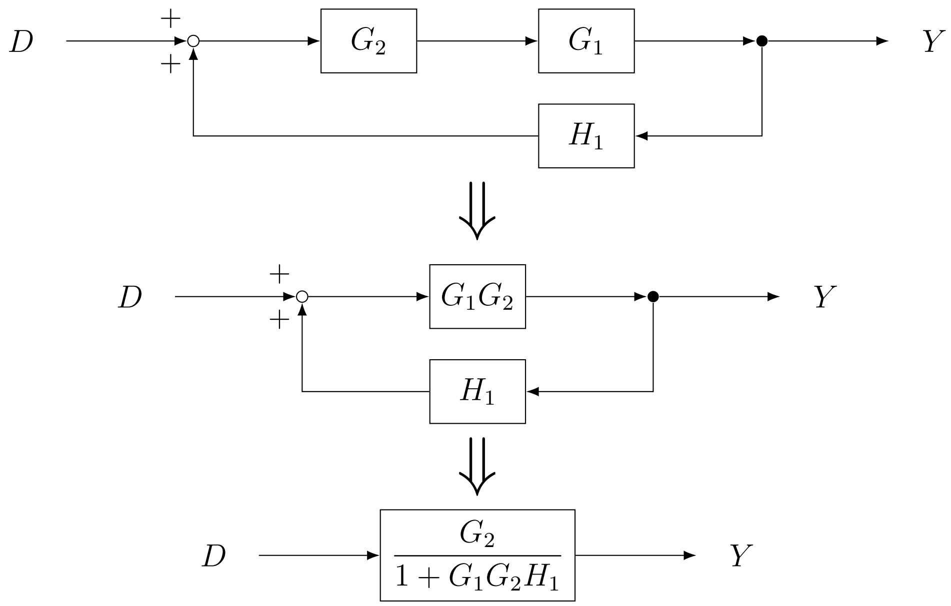
[41] 出力信号である制御量Yまでの伝達特性を等価変換によって簡単化せよ．
ただし、Rは目標値信号，Dは外乱信号である．



R から Y について



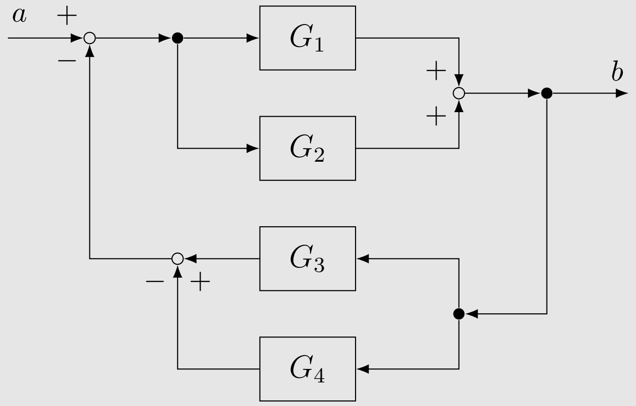
D から Y について

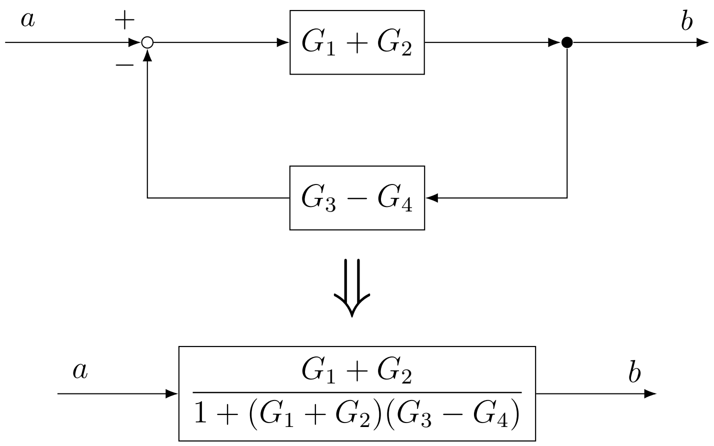


これらを合わせて

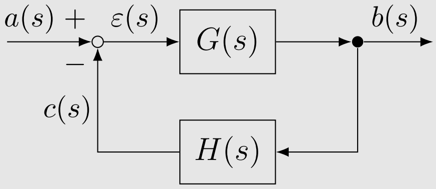
$$Y = \frac{G_1 G_2 G_3 R + G_2 D}{1 + G_1 G_2 H_1}$$

[42] a を入力，b を出力としたとき，ブロック線図を簡単化し，伝達関数を求めよ．





[43] 伝達関数 $\frac{b(s)}{a(s)}$ を求めよ.



ブロック線図より次が成り立つ

$$\begin{cases} \varepsilon(s) = a(s) - c(s) & \cdots (1) \\ b(s) = \varepsilon(s)G(s) & \cdots (2) \\ c(s) = b(s)H(s) & \cdots (3) \end{cases}$$

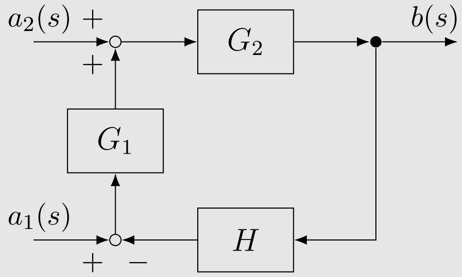
であるから、最終的に $\varepsilon(s), c(s)$ を含まない形にするために $\varepsilon(s)$ について解くと (1), (3) より

$$\varepsilon(s) = a(s) - b(s)H(s) \qquad \cdots (4)$$

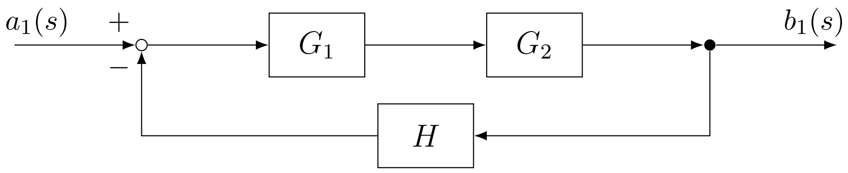
よって (2), (4) より

$$\begin{aligned} &\frac{b(s)}{G(s)} = \varepsilon(s) \\ \Leftrightarrow\ &\frac{b(s)}{G(s)} = a(s) - b(s)H(s) \\ \Leftrightarrow\ &b(s) = a(s)G(s) - b(s)H(s)G(s) \\ \Leftrightarrow\ &b(s)\left\{1 + G(s)H(s)\right\} = a(s)G(s) \\ \Leftrightarrow\ &\frac{b(s)}{a(s)} = \frac{G(s)}{1 + G(s)H(s)} \end{aligned}$$

[44] 二つの入力信号 $a_1(s), a_2(s)$ をもつ，制御系の応答 $b(s)$ を求めよ．

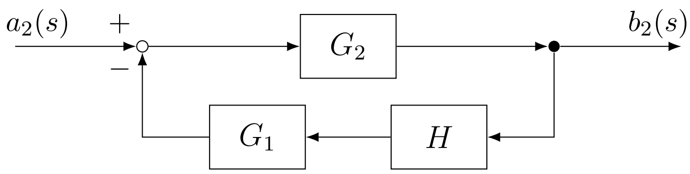


$a_2(s) = 0$ とおくと



$$b_1(s) = \frac{G_1 G_2}{1 + G_1 G_2 H} \cdot a_1(s) \qquad \cdots (1)$$

$a_2(s) = 0$ とおくと

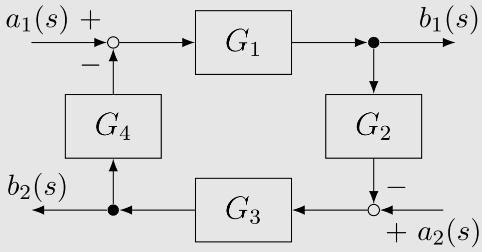


$$b_2(s) = \frac{G_2}{1 + G_1 G_2 H} \cdot a_2(s) \qquad \cdots (2)$$

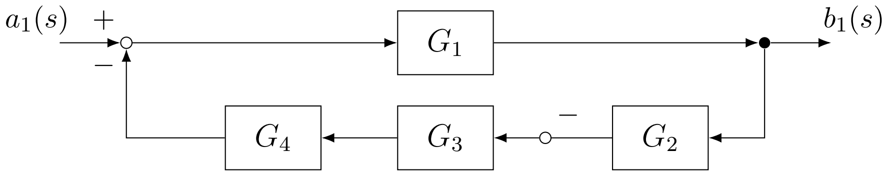
以上 (1), (2) より

$$\begin{aligned} b(s) &= b_1(s) + b_2(s) \\ &= \frac{G_1 G_2 a_1(s) + G_2 a_2(s)}{1 + G_1 G_2 H} \end{aligned}$$

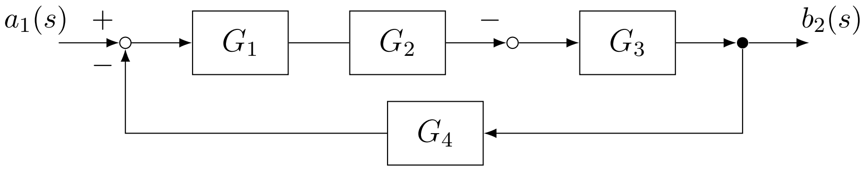
[45] $\frac{b_1(s)}{a_1(s)}, \frac{b_1(s)}{a_2(s)}, \frac{b_2(s)}{a_1(s)}, \frac{b_2(s)}{a_2(s)}$ を求めよ.



$a_2(s) = 0$ として

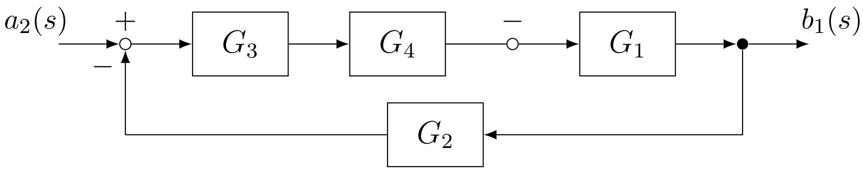


$$\frac{b_1(s)}{a_1(s)} = \frac{1}{1 - G_1G_2G_3G_4}$$

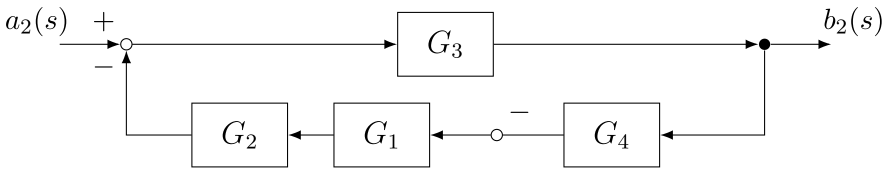


$$\frac{b_1(s)}{a_1(s)} = \frac{1}{1 - G_1G_2G_3G_4}$$

$a_1(s) = 0$ として

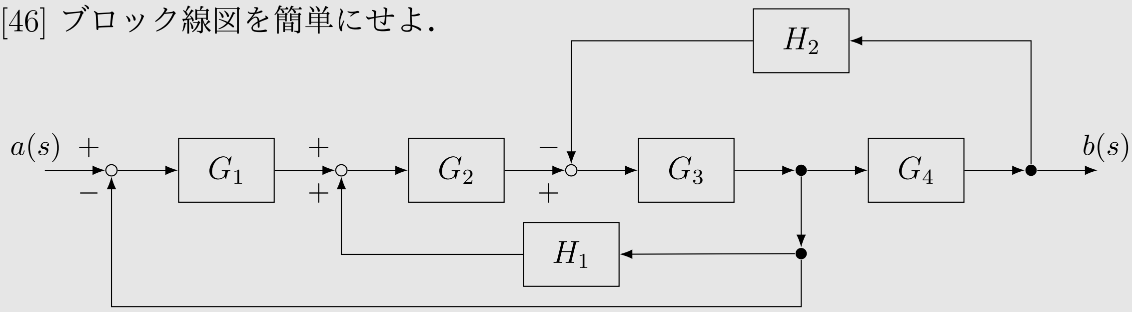


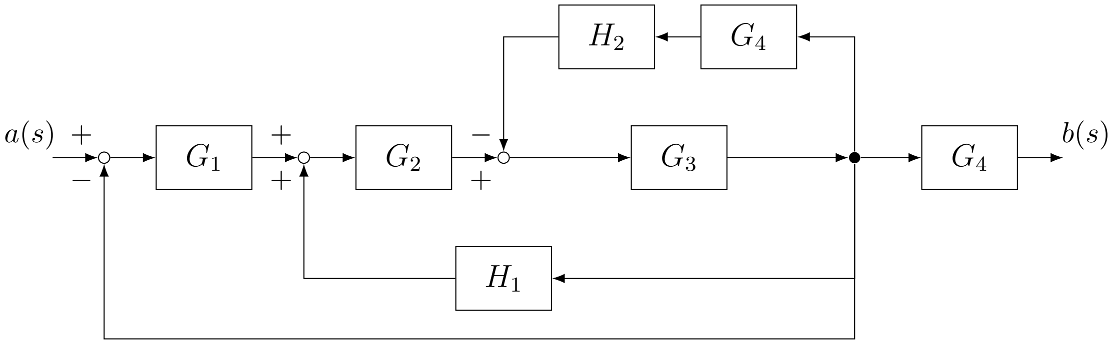
$$\frac{b_1(s)}{a_1(s)} = \frac{1}{1 - G_1G_2G_3G_4}$$



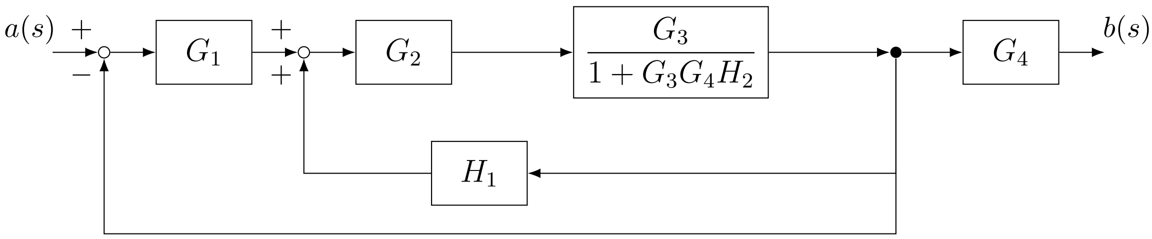
$$\frac{b_1(s)}{a_1(s)} = \frac{1}{1 - G_1G_2G_3G_4}$$

[46] ブロック線図を簡単にせよ.

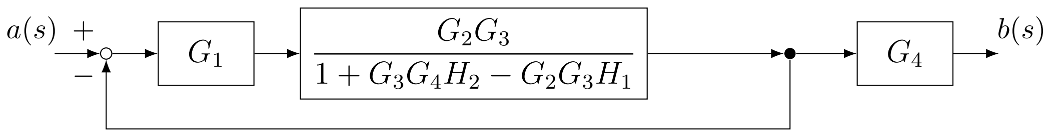




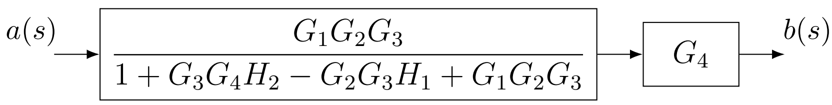
$$\Downarrow$$



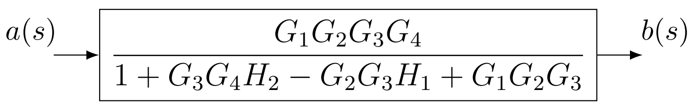
$$\Downarrow$$



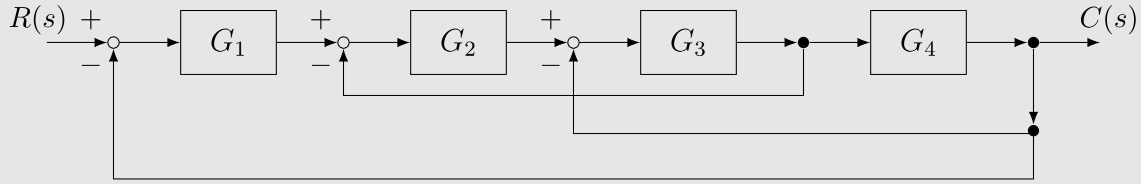
$$\Downarrow$$

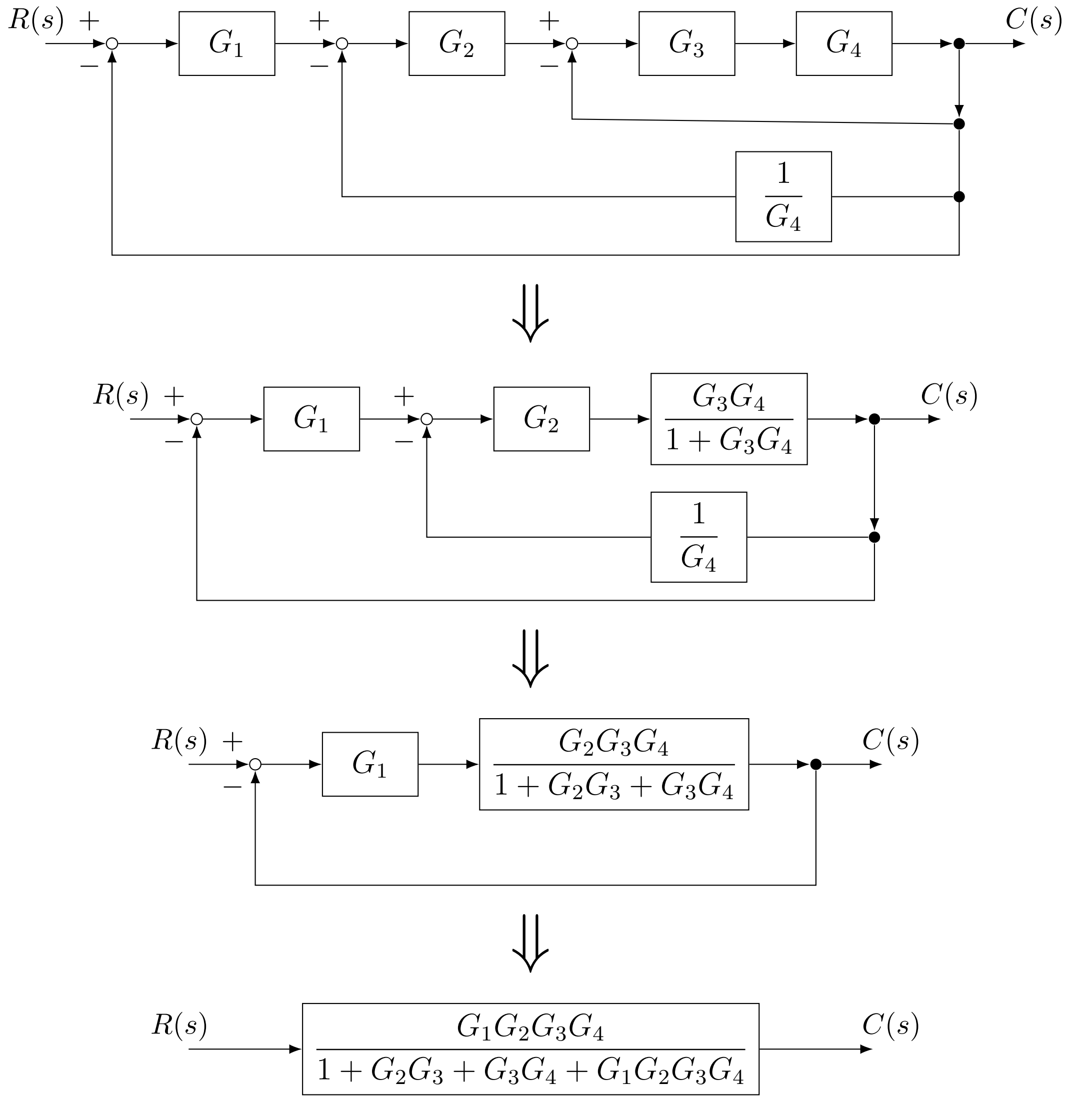


$$\Downarrow$$

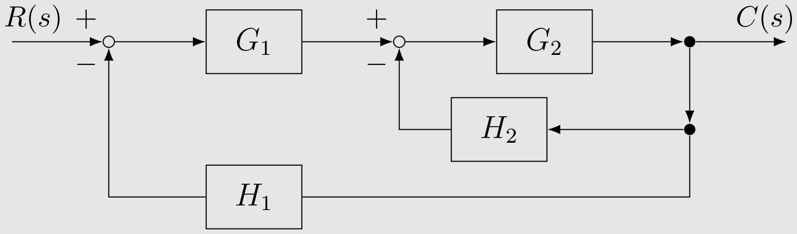


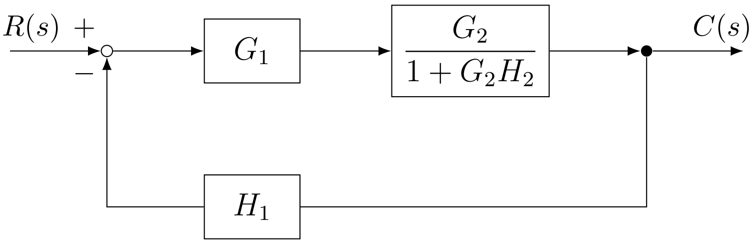
[47] ブロック線図を簡単にせよ．





[48] ブロック線図を簡単にせよ．





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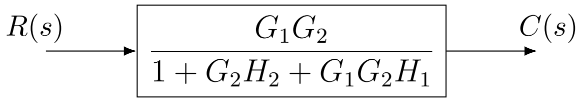
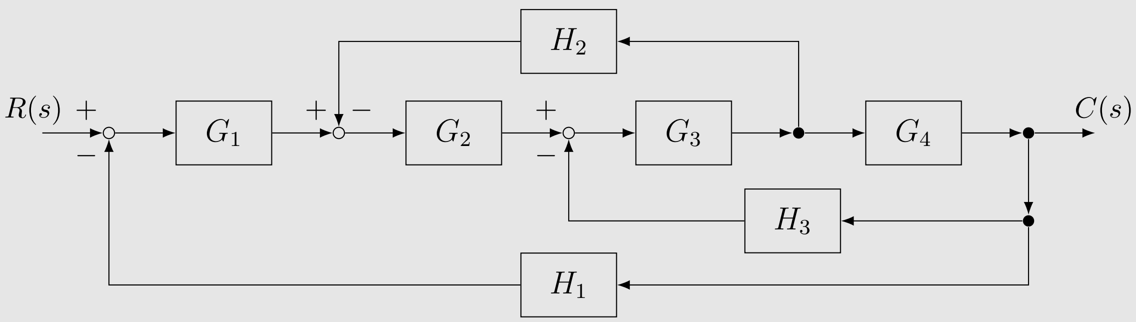
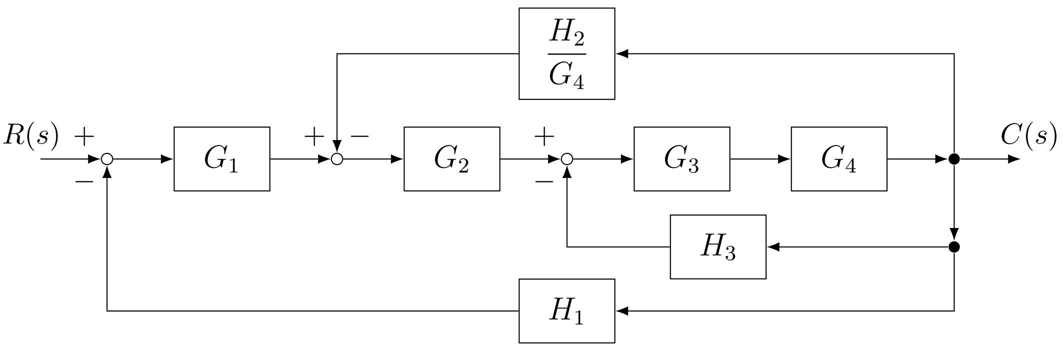
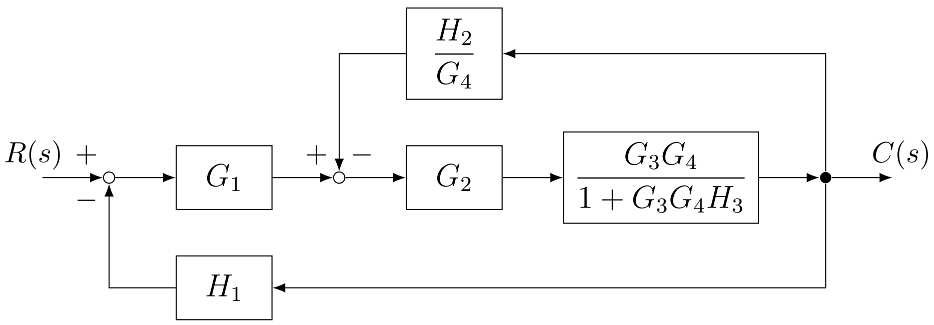


[49] ブロック線図を簡単にせよ.





$$\Downarrow$$



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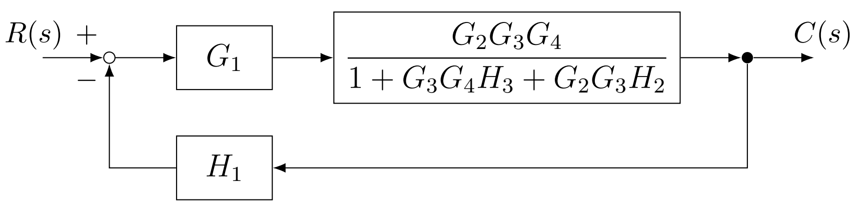

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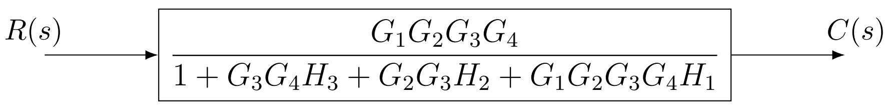
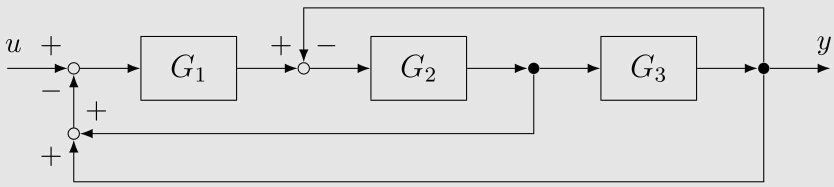
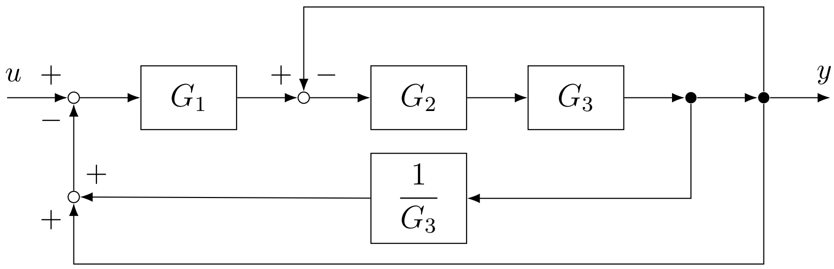
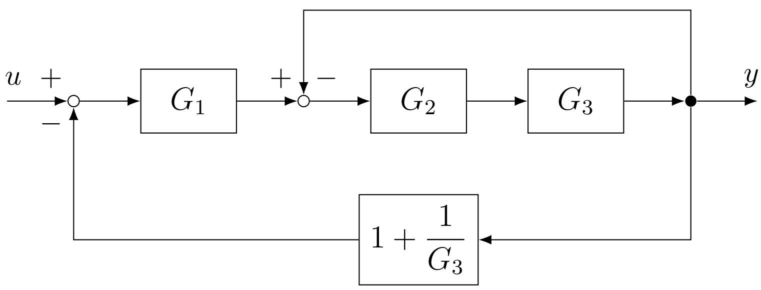


[50] ブロック線図を簡単にせよ．

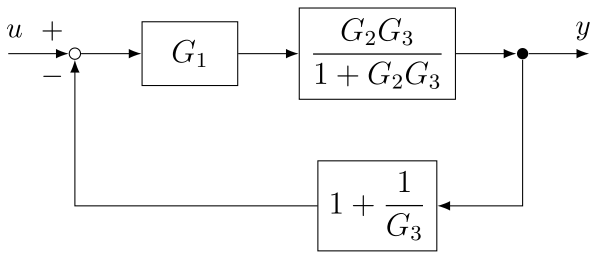




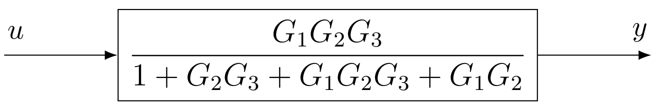
$$\Downarrow$$



$$\Downarrow$$



$$\Downarrow$$



最後の変形について

$$\frac{G_1\cdot\dfrac{G_2G_3}{1+G_2G_3}}{1+G_1\cdot\dfrac{G_2G_3}{1+G_2G_3}\cdot\left(1+\dfrac{1}{G_3}\right)}=\frac{G_1G_2G_3}{1+G_2G_3+G_1G_2G_3\left(1+\dfrac{1}{G_3}\right)}$$

$$=\frac{G_1G_2G_3}{1+G_2G_3+G_1G_2+G_1G_2G_3}$$