Control Systems

Topics Covered

Block diagram reduction technique

Figure 2.14
Second-order feedback control system
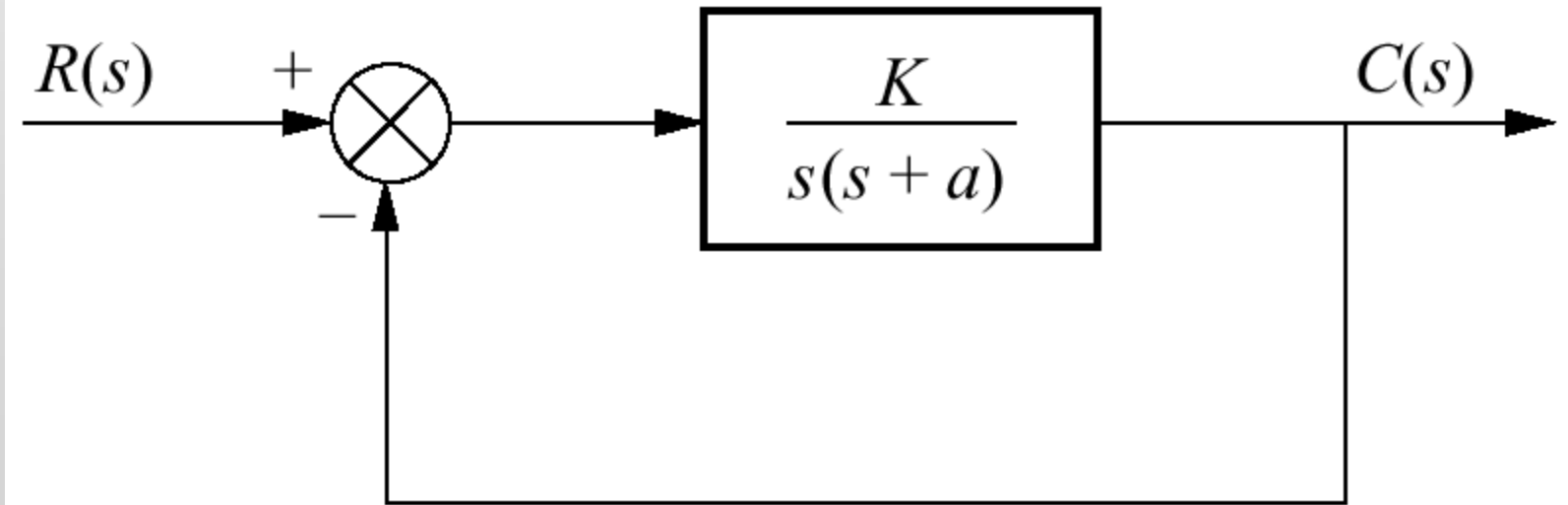

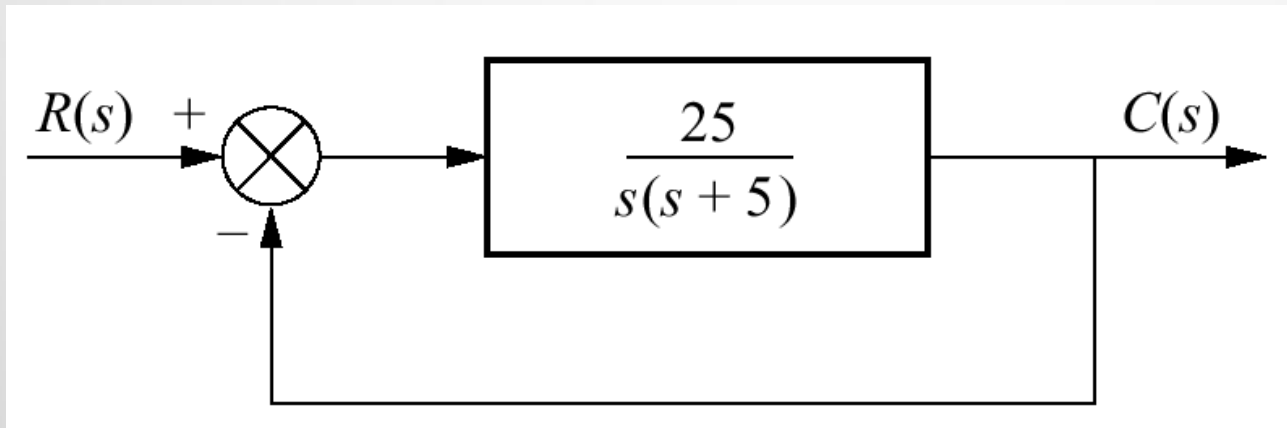$R(s)$ $+$ $\bigotimes$ $-$ $\dfrac{K}{s(s+a)}$ $C(s)$

Figure 2.15
Feedback system

Figure 2.16
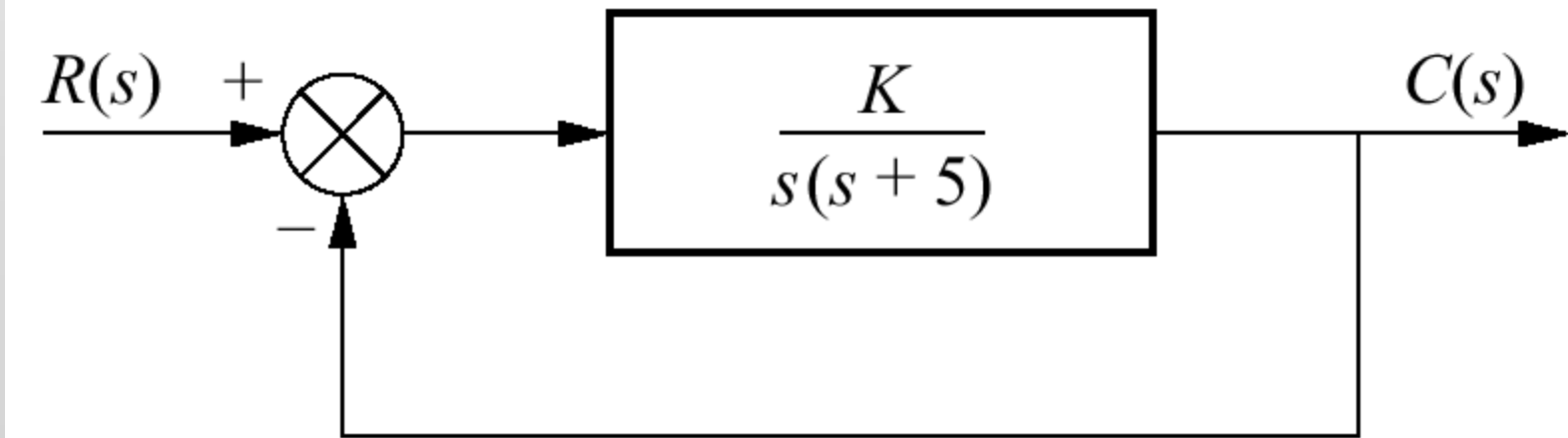Feedback system

$$\frac{K}{s(s+5)}$$

R(s), +, −, C(s)

Figure 5.34 *Alvin*, a manned submersible, explored the wreckage of the *Titanic* with a tethered robot, *Jason Junior.*
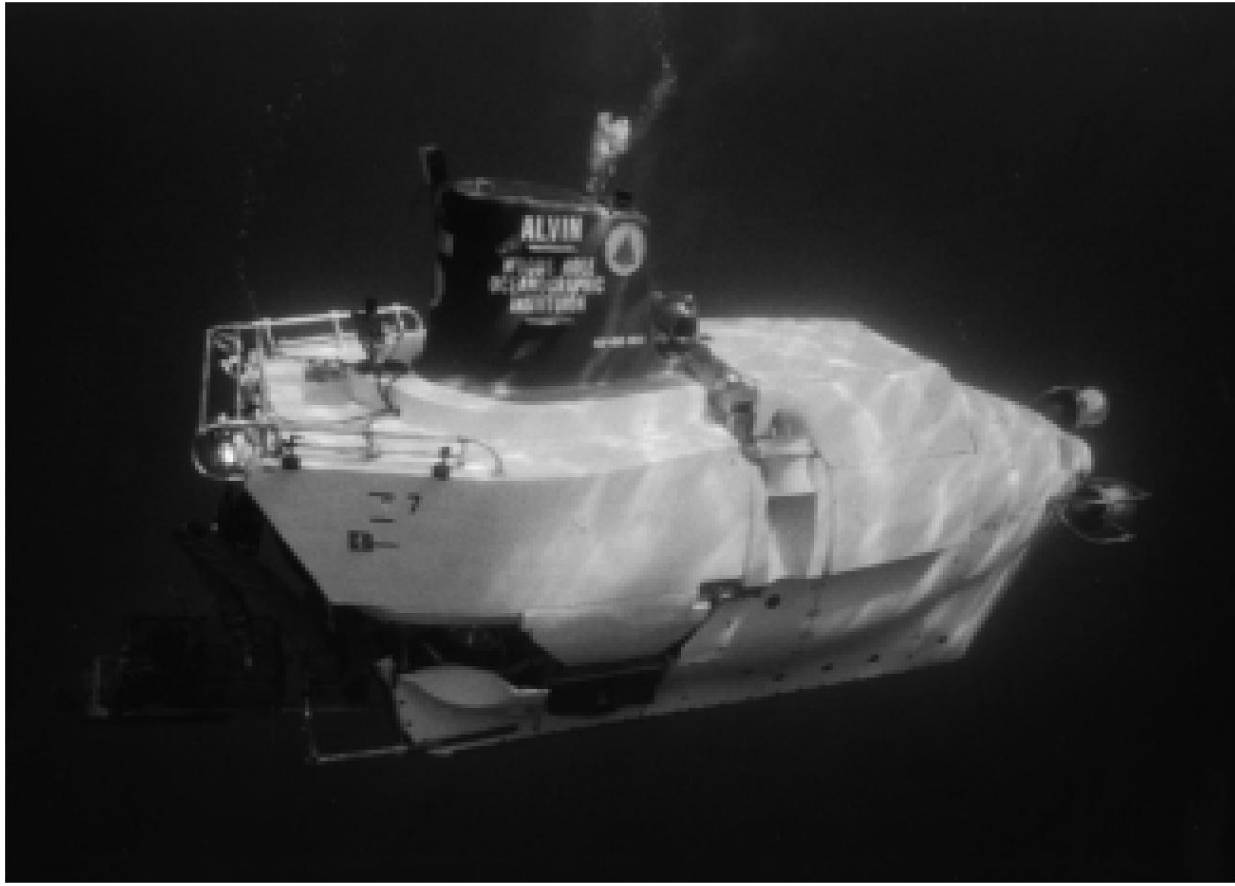
Figure 5.35

Block diagram reduction for the antenna azimuth position control system:
a. original;
b. pushing input potentiometer to the right past the summing junction;
c. showing equivalent forward transfer function;
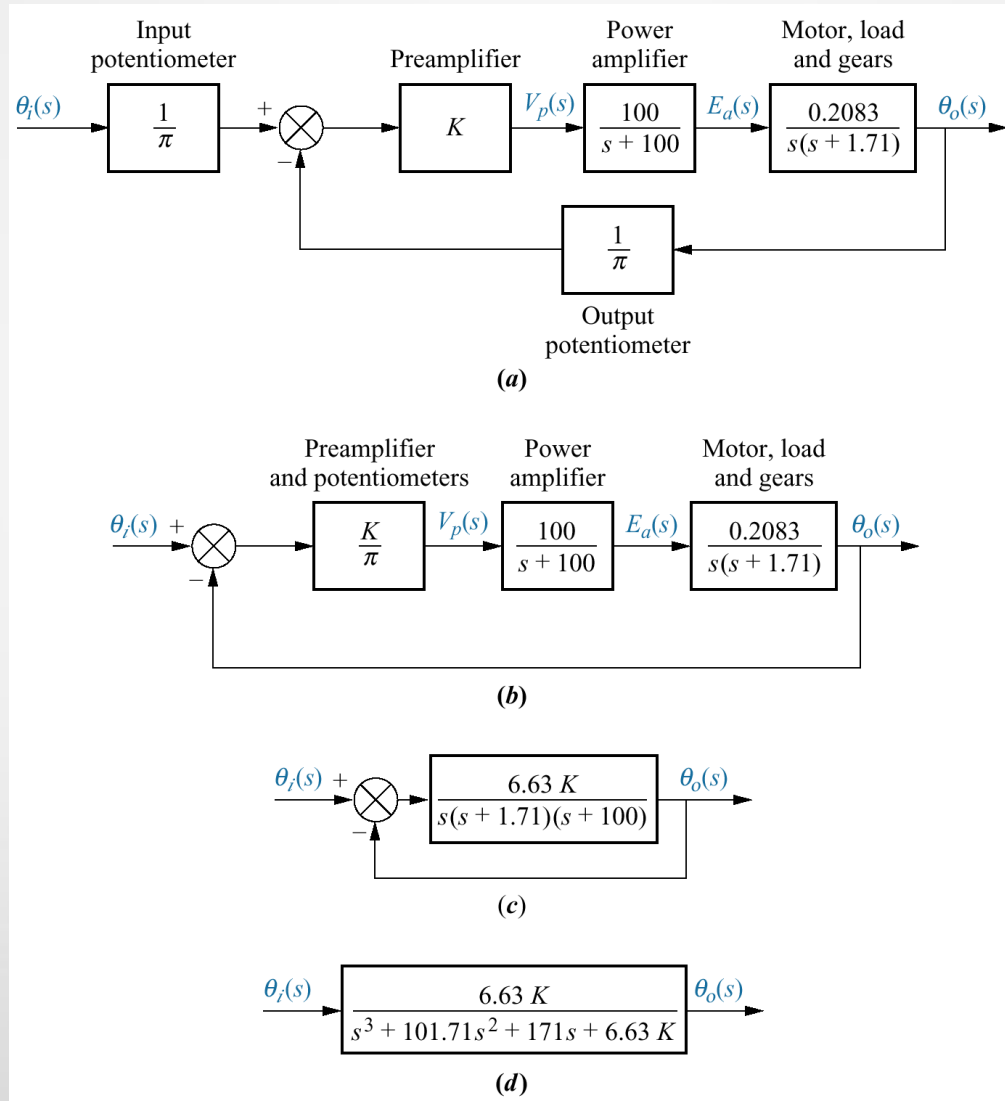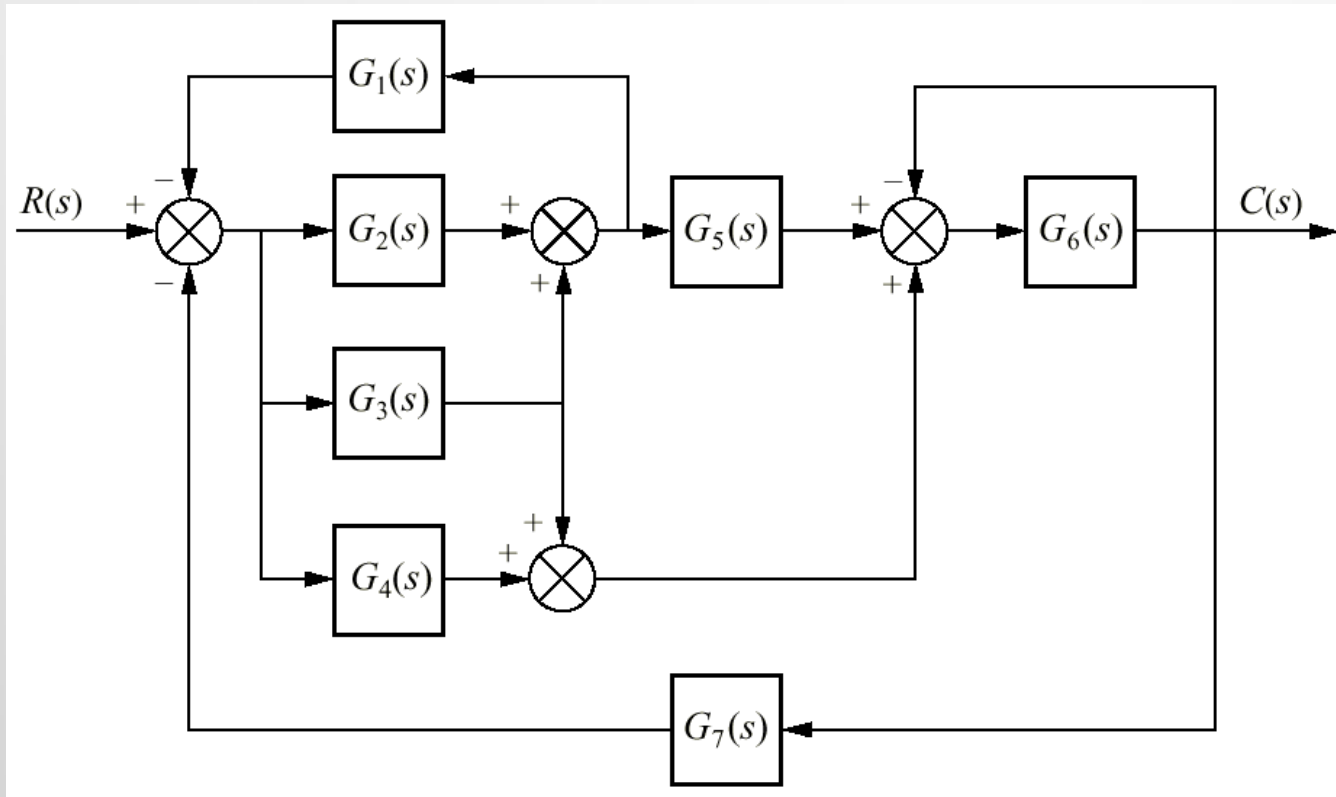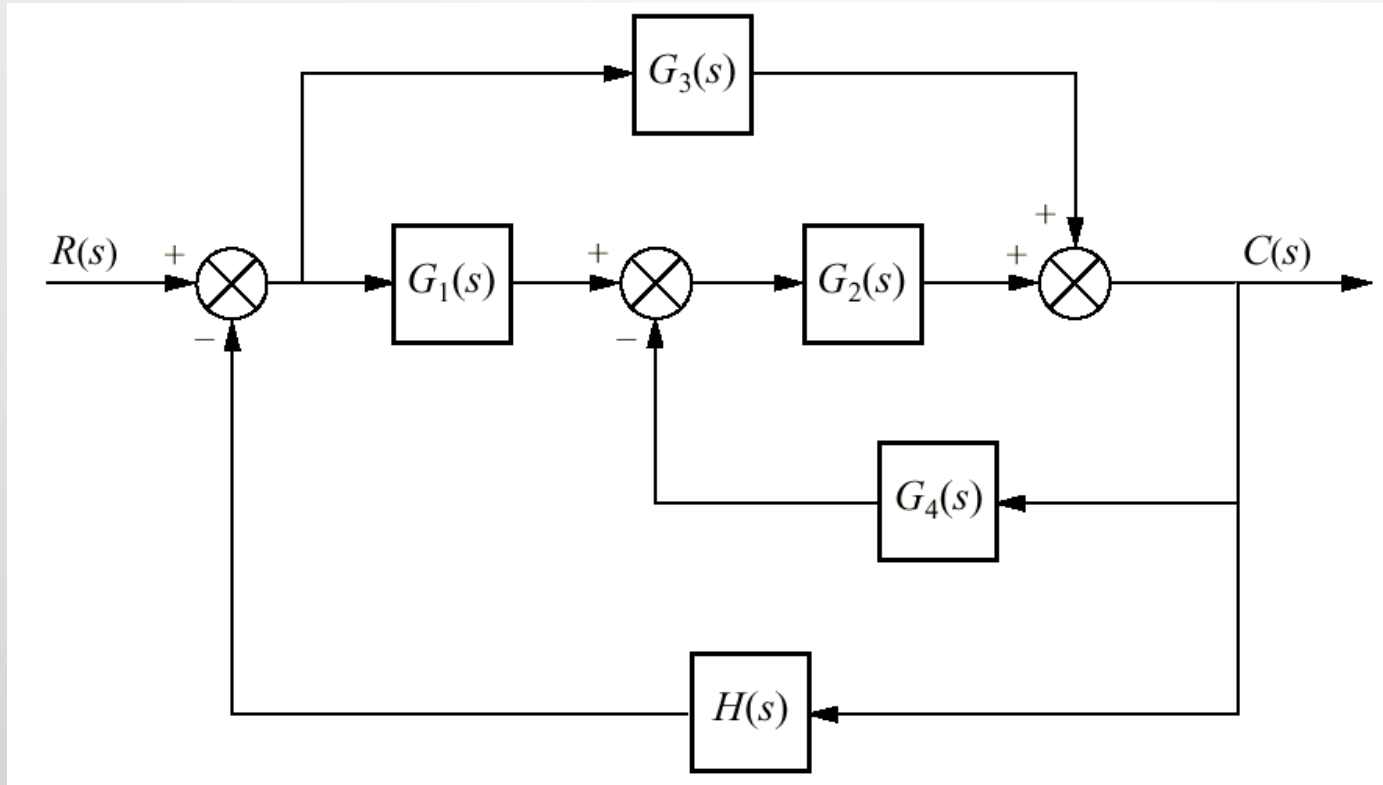**d.** final closed-loop transfer function

Input potentiometer — Preamplifier — Power amplifier — Motor, load and gears

$\theta_i(s)$ → $\dfrac{1}{\pi}$ → (+) (−) → K → $V_p(s)$ → $\dfrac{100}{s+100}$ → $E_a(s)$ → $\dfrac{0.2083}{s(s+1.71)}$ → $\theta_o(s)$

$\dfrac{1}{\pi}$ Output potentiometer

(a)

Preamplifier and potentiometers — Power amplifier — Motor, load and gears

$\theta_i(s)$ (+) (−) → $\dfrac{K}{\pi}$ → $V_p(s)$ → $\dfrac{100}{s+100}$ → $E_a(s)$ → $\dfrac{0.2083}{s(s+1.71)}$ → $\theta_o(s)$

(b)

$\theta_i(s)$ (+) (−) → $\dfrac{6.63\,K}{s(s+1.71)(s+100)}$ → $\theta_o(s)$

(c)

$\theta_i(s)$ → $\dfrac{6.63\,K}{s^3 + 101.71s^2 + 171s + 6.63\,K}$ → $\theta_o(s)$
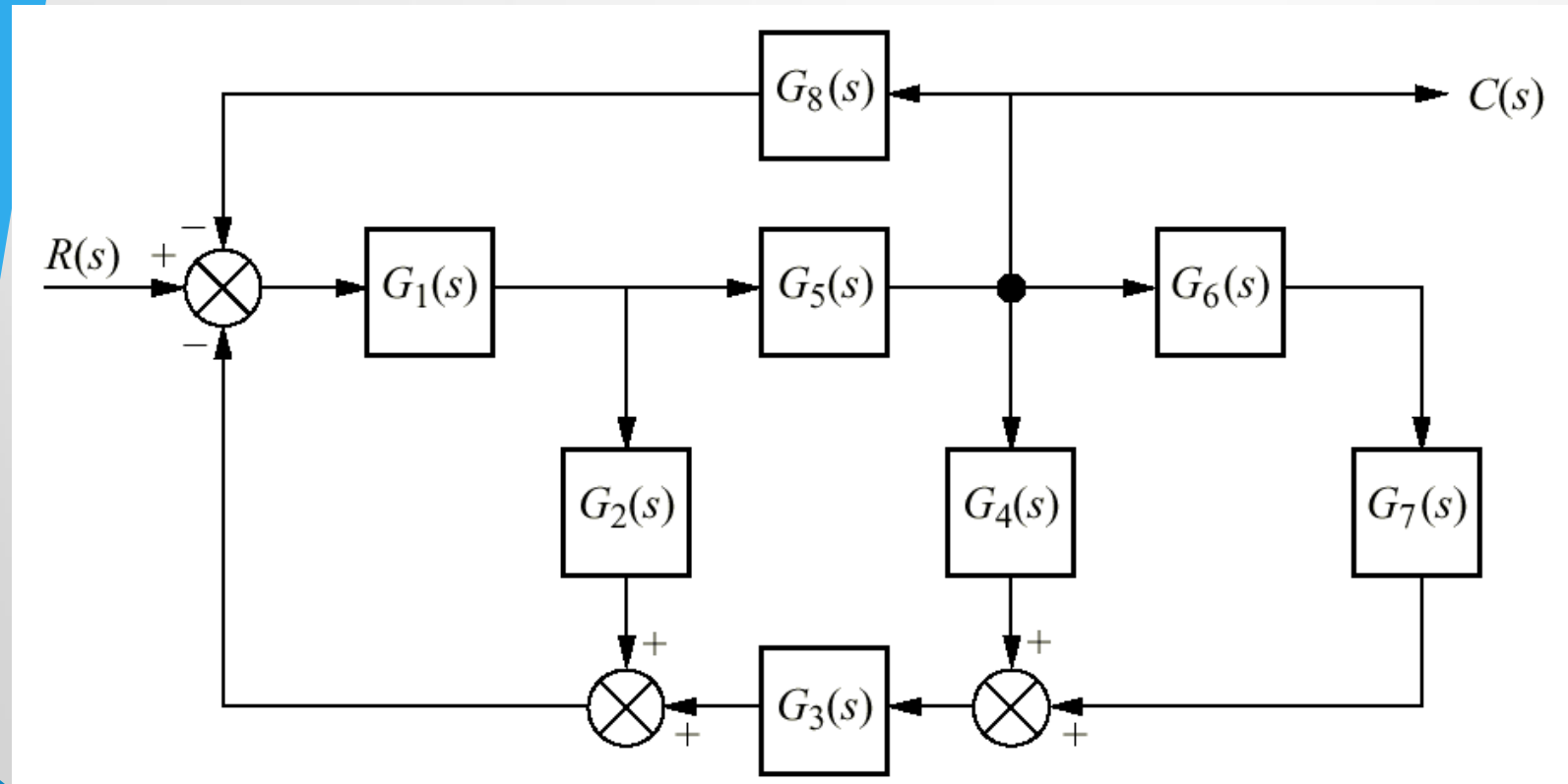
(d)

7

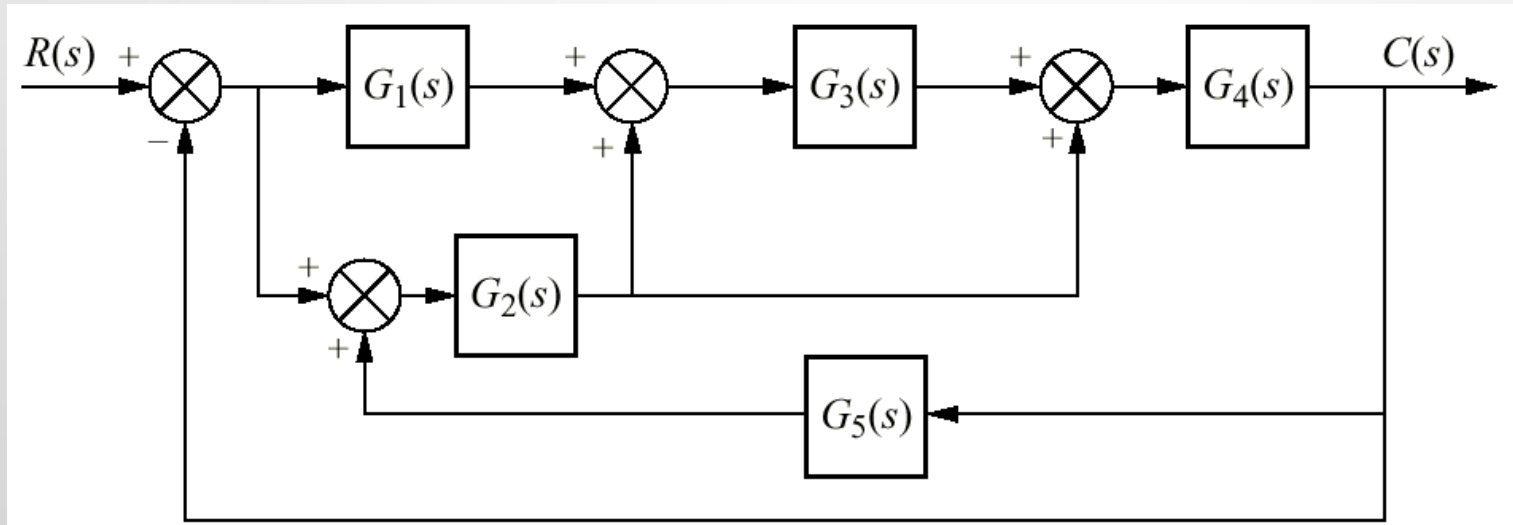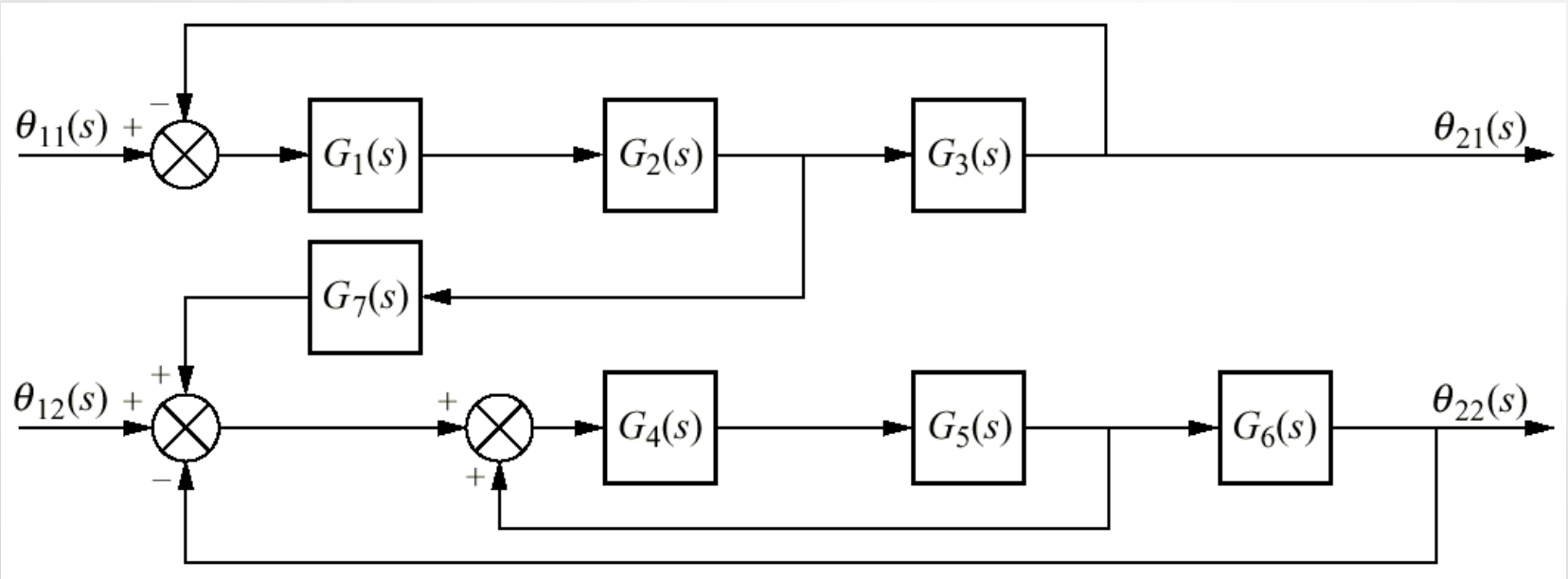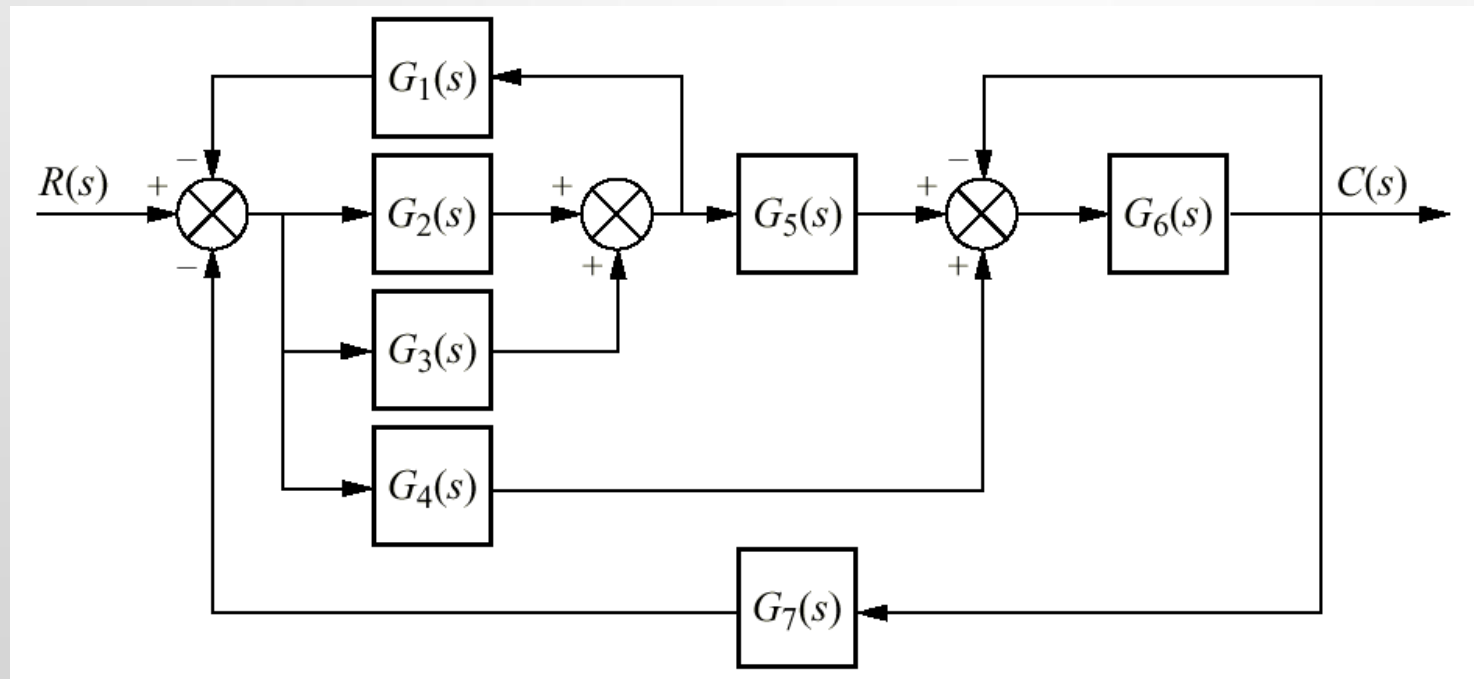# Figure P5.3

Figure P5.4

Figure P5.5
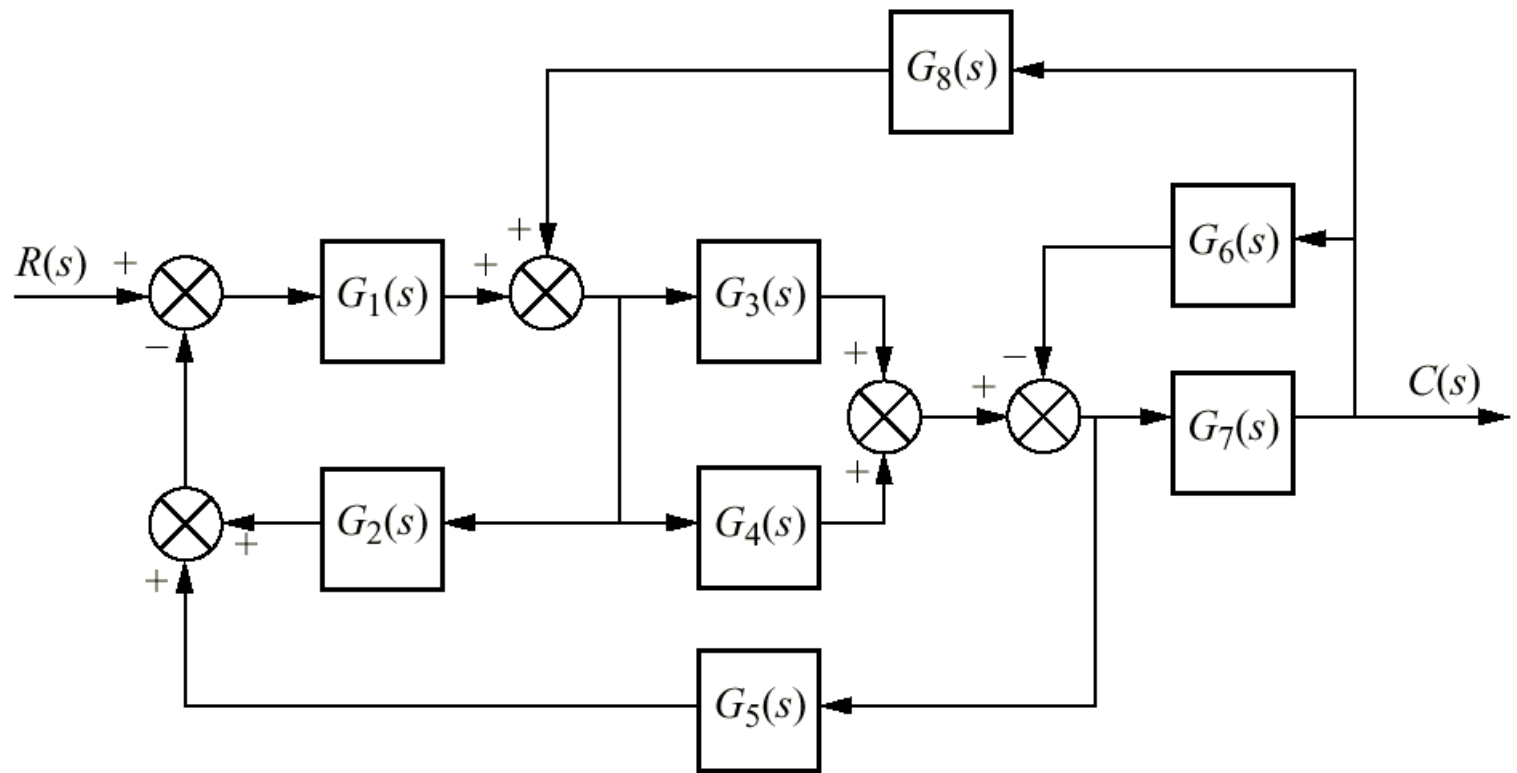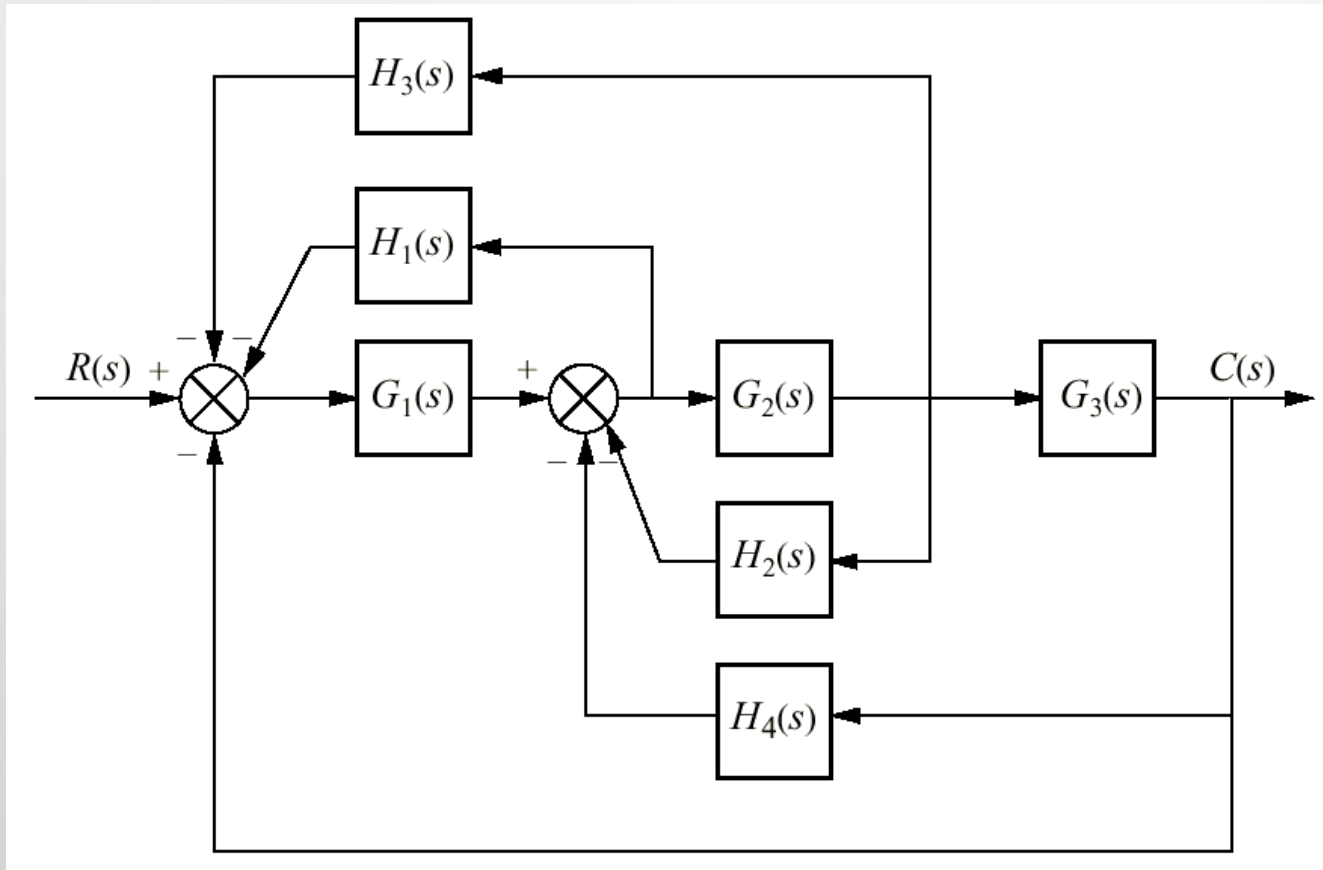
Figure P5.6

Figure P5.7

Figure P5.8

Figure P5.9

Figure P5.10

Figure P5.16