

HW1

4-7. The block diagram of the position-control system of an electronic word processor is shown in Fig. 4P-7.

(a) Find the loop transfer function $\Theta_o(s)/\Theta_e(s)$ (the outer feedback path is open).

(b) Find the closed-loop transfer function $\Theta_o(s)/\Theta_r(s)$.

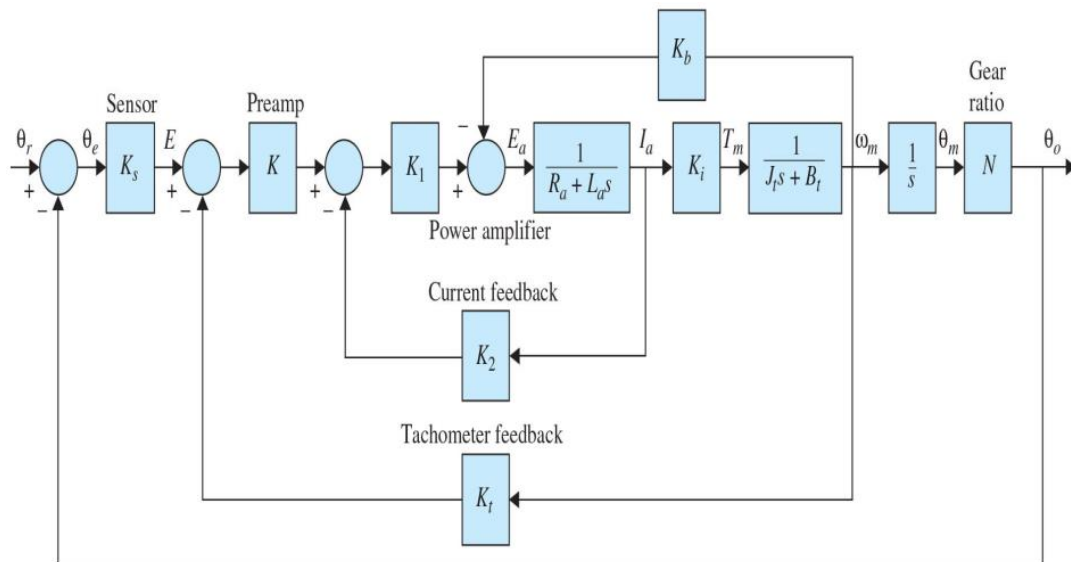


Figure 4P-7

4-8. The block diagram of a feedback control system is shown in Fig. 4P-8. Find

the following transfer functions: **(a)** $\left. \frac{Y(s)}{R(s)} \right|_{N=0}$

(b) $\left. \frac{Y(s)}{E(s)} \right|_{N=0}$

(c) $\left. \frac{Y(s)}{N(s)} \right|_{R=0}$

(d) Find the output $Y(s)$ when $R(s)$ and $N(s)$ are applied simultaneously.

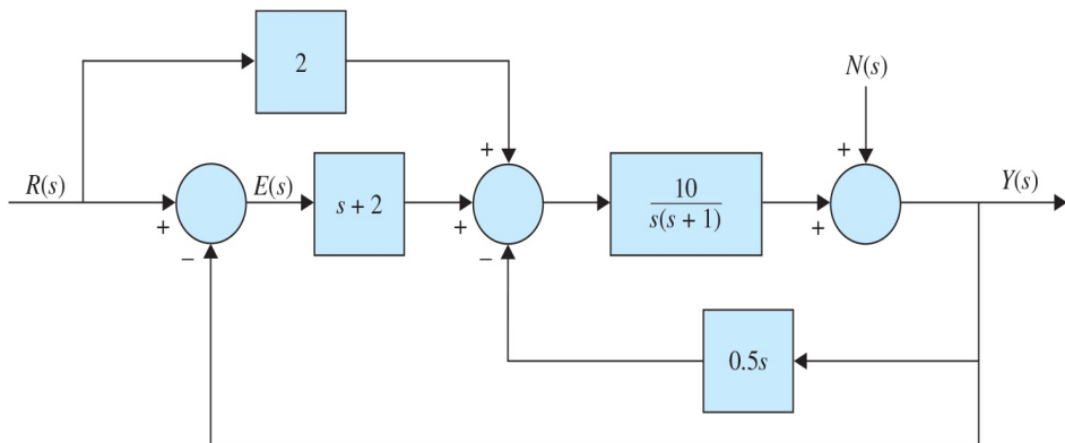


Figure 4P-8

4-9. The block diagram of a feedback control system is shown in Fig. 4P-9.

(a) Apply the SFG gain formula directly to the block diagram to find the transfer functions:

$$\left. \frac{Y(s)}{R(s)} \right|_{N=0} \quad \left. \frac{Y(s)}{N(s)} \right|_{R=0}$$

Express $Y(s)$ in terms of $R(s)$ and $N(s)$ when both inputs are applied simultaneously.

(b) Find the desired relation among the transfer functions $G_1(s)$, $G_2(s)$, $G_3(s)$, $G_4(s)$, $H_1(s)$ and $H_2(s)$ so that the output $Y(s)$ is not affected by the disturbance signal $N(s)$ at all.

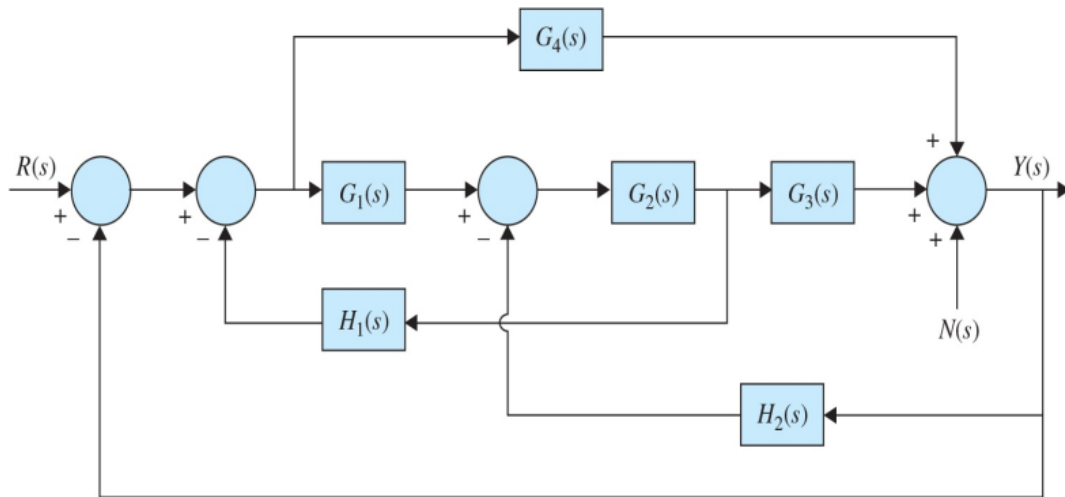


Figure 4P-9

4-20. Draw signal-flow graphs for the following sets of algebraic equations. These equations should first be arranged in the form of cause-and-effect relations before SFGs can be drawn. Show that there are many possible SFGs for each set of equations.

$$x_1 = -x_2 - 3x_3 + 3$$

$$x_2 = 5x_1 - 2x_2 + x_3$$

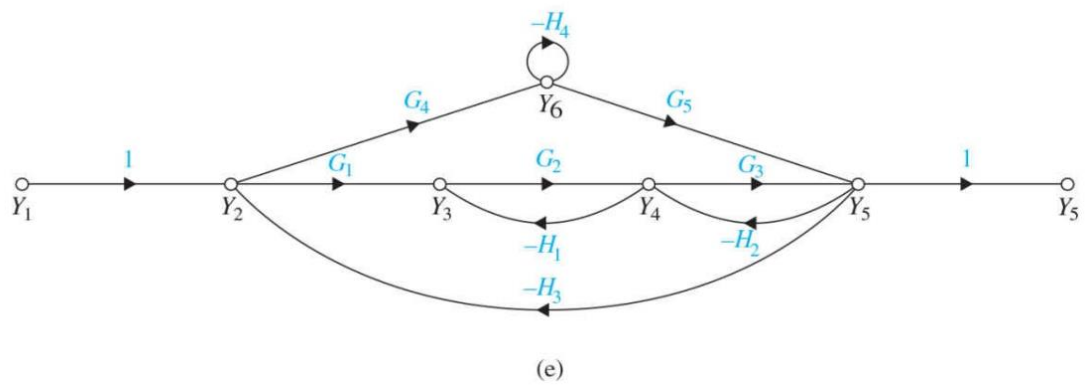
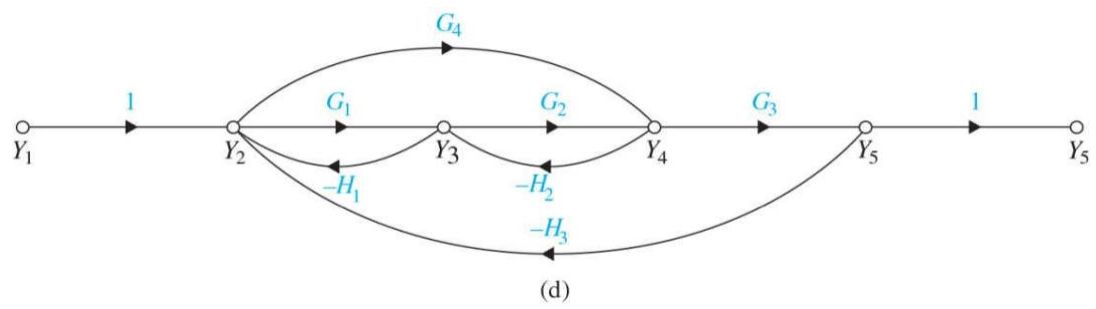
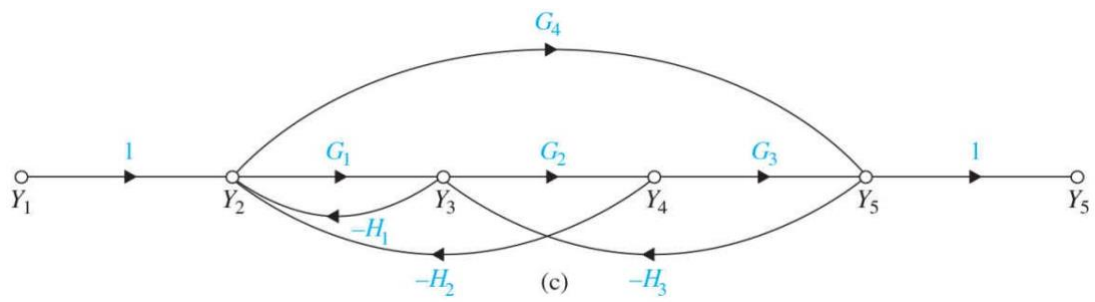
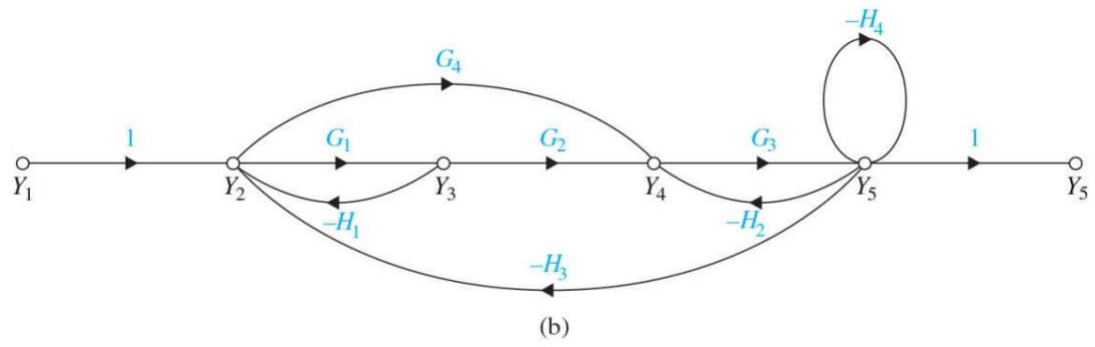
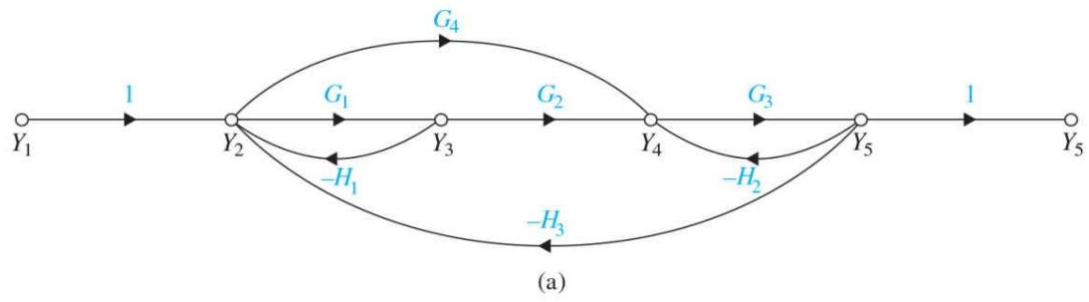
(a) $x_3 = 4x_1 + x_2 - 5x_3 + 5$

$$2x_1 + 3x_2 + x_3 = -1$$

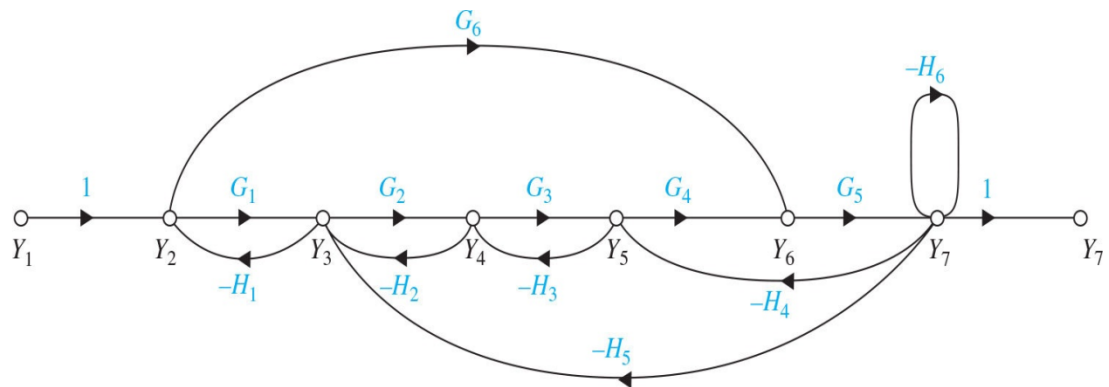
$$x_1 - 2x_2 - x_3 = 1$$

(b) $3x_2 + x_3 = 0$

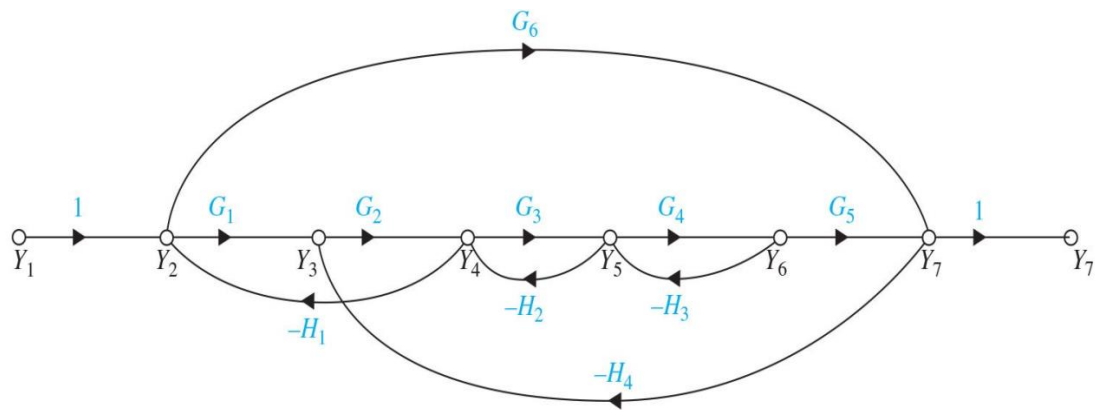
4-22. Apply the gain formula to the SFGs shown in Fig. 4P-22 to find the following transfer functions: $\frac{Y_5}{Y_1}$, $\frac{Y_4}{Y_1}$, $\frac{Y_2}{Y_1}$, $\frac{Y_5}{Y_2}$.



4-23. Find the transfer functions Y_7/Y_1 and Y_2/Y_1 of the SFGs shown in Fig. 4P-23.



(a)



(b)

4-27. Find the following transfer functions for the SFG shown in Fig. 4P-27.

$$\left. \frac{Y_6}{Y_1} \right|_{Y_7=0} \quad \left. \frac{Y_6}{Y_7} \right|_{Y_1=0}$$

