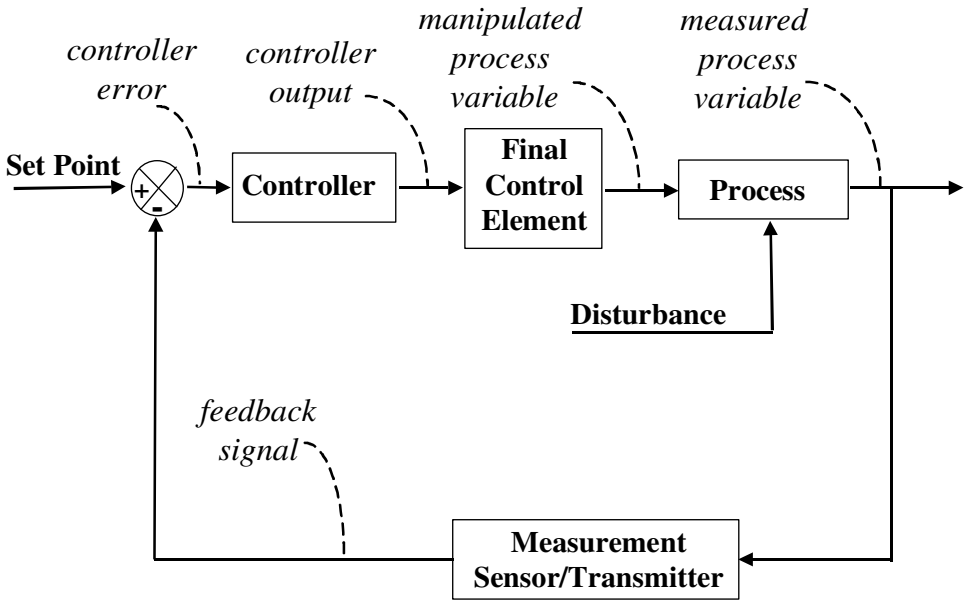
Block Diagram Overview



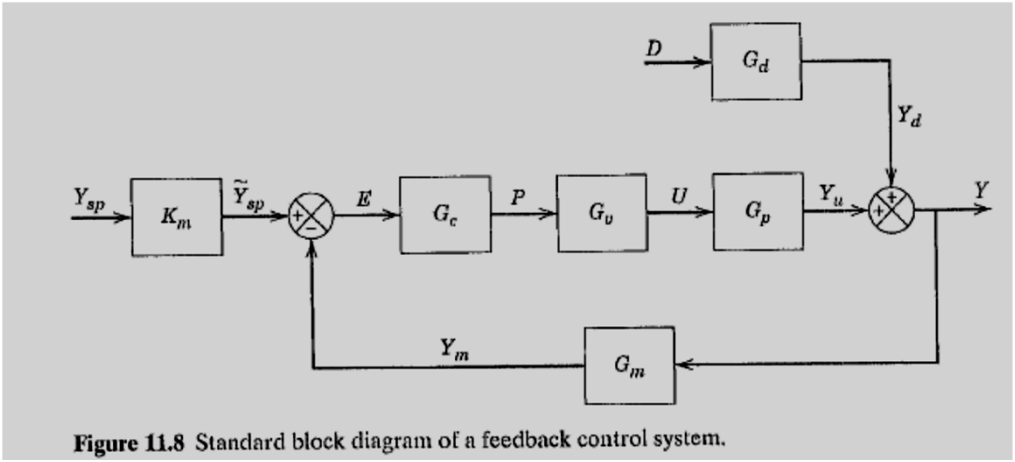


Figure 11.8 Standard block diagram of a feedback control system.

Obtain a Closed Loop Transfer Function

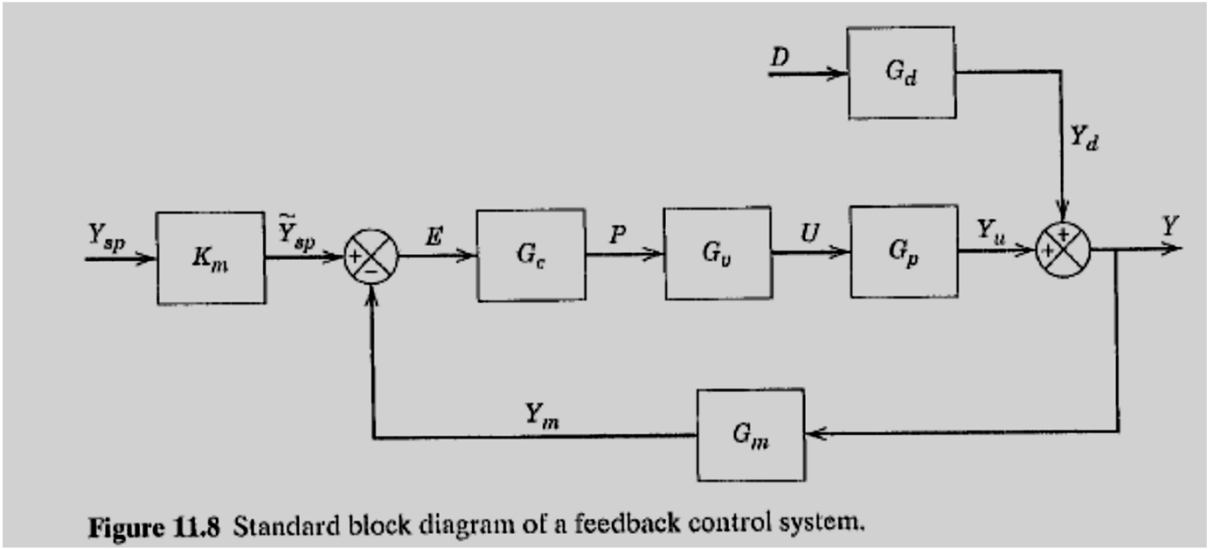


Figure 11.8 Standard block diagram of a feedback control system.

Procedure

1. Label All Signals
2. Write Equation for *Each* Signal
3. Substitute Equations to Solve for Y/Ysp and Y/D

Note: Shortcut (G_{cl} = Direct / (1+Loop)) method applicable to standard feedback system (Fig. 11.8)

Write Equation for Each Signal

$$\tilde{Y}_{sp} = K_m Y_{sp}$$

$$Y_m = G_m Y$$

$$E = \tilde{Y}_{sp} - Y_m$$

$$P = G_c E$$

$$U = G_v P$$

$$Y_u = G_p U$$

$$Y_d = G_d D$$

$$Y = Y_u + Y_d$$

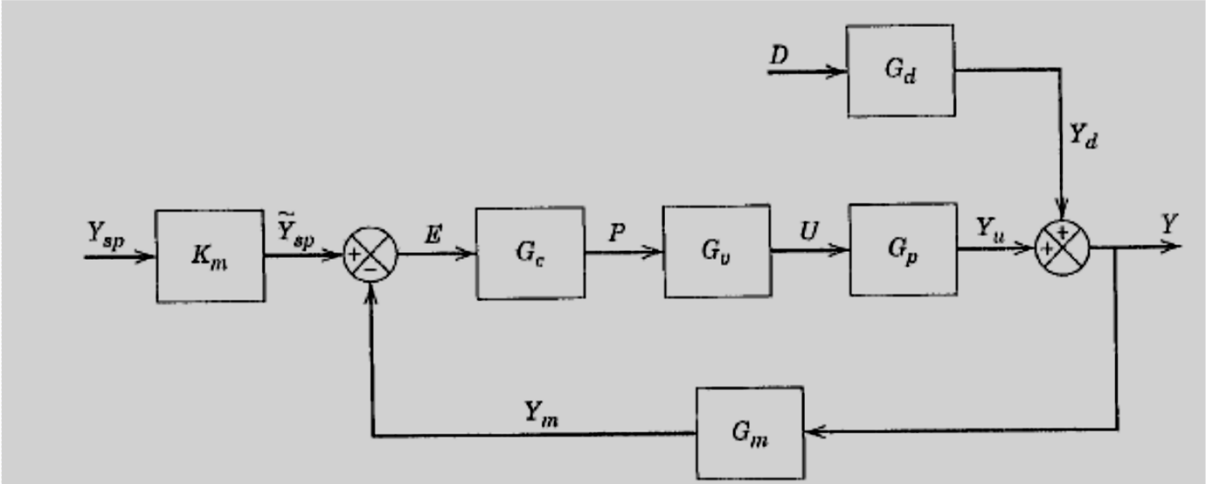


Figure 11.8 Standard block diagram of a feedback control system.

Substitute Equations

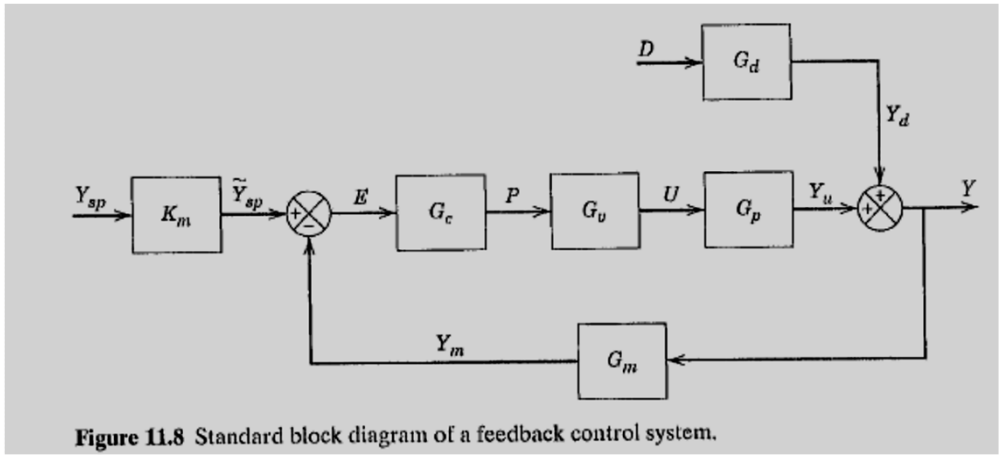


Figure 11.8 Standard block diagram of a feedback control system.

$$\tilde{Y}_{sp} = K_m Y_{sp}$$

$$Y_m = G_m Y$$

$$E = \tilde{Y}_{sp} - Y_m = K_m Y_{sp} - G_m Y$$

$$P = G_c E = G_c \left(K_m Y_{sp} - G_m Y \right)$$

$$U = G_v P = G_v G_c \left(K_m Y_{sp} - G_m Y \right)$$

$$Y_u = G_p U = G_p G_v G_c \left(K_m Y_{sp} - G_m Y \right)$$

$$Y_d = G_d D$$

$$Y = Y_u + Y_d = G_p G_v G_c \left(K_m Y_{sp} - G_m Y \right) + G_d D$$

Solve for Y/Ysp and Y/D

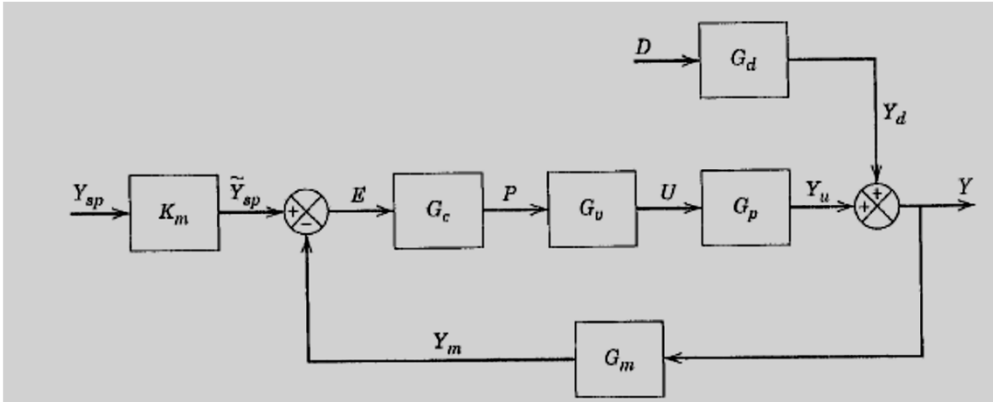


Figure 11.8 Standard block diagram of a feedback control system.

$$Y = G_p G_v G_c \left(K_m Y_{sp} - G_m Y\right) + G_d D$$

$$Y + G_p G_v G_c G_m Y = G_p G_v G_c K_m Y_{sp} + G_d D$$

$$Y(1 + G_p G_v G_c G_m) = G_p G_v G_c K_m Y_{sp} + G_d D$$

$$Y = \frac{G_p G_v G_c K_m}{1 + G_p G_v G_c G_m} Y_{sp} + \frac{G_d}{1 + G_p G_v G_c G_m} D$$