

RM. HAFIZ

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Example 2-3

$$G(s) = C(sI - A)^{-1}B + D$$

$$= [1 \ 0] \left\{ \begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - \begin{bmatrix} 0 & 1 \\ -\frac{k}{m} & -\frac{b}{m} \end{bmatrix} \right\}^{-1} \begin{bmatrix} 0 \\ \frac{1}{m} \end{bmatrix} + 0$$

$$= [1 \ 0] \begin{bmatrix} s & -1 \\ \frac{k}{m} & s + \frac{b}{m} \end{bmatrix}^{-1} \begin{bmatrix} 0 \\ \frac{1}{m} \end{bmatrix}$$

$$\begin{bmatrix} s & -1 \\ \frac{k}{m} & s + \frac{b}{m} \end{bmatrix}^{-1} = \frac{1}{s^2 + \frac{b}{m}s + \frac{k}{m}} \begin{bmatrix} s + \frac{b}{m} & 1 \\ -\frac{k}{m} & s \end{bmatrix}$$

$$G(s) = \frac{1}{ms^2 + bs + k}$$

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \quad u = \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix}$$

$$Y(s) = G(s) \cdot U(s)$$

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} = \frac{1}{ms^2 + bs + k} \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} = \begin{bmatrix} \frac{1}{ms^2 + bs + k} u_1 \\ \frac{1}{ms^2 + bs + k} u_2 \\ \vdots \\ \frac{1}{ms^2 + bs + k} u_n \end{bmatrix}$$

x 2.3 $G(s) = C(sI - A)^{-1}B + 0$

$$\frac{Y(s)}{U(s)} = \left([0 \ 1 \ 0] \begin{bmatrix} s & 0 & 0 \\ 0 & s & 0 \\ 0 & 0 & s \end{bmatrix} - \begin{bmatrix} -M & -56 & -160 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \right)^{-1} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + 0$$

$$\frac{Y(s)}{U(s)} = [0 \ 1 \ 0] \begin{bmatrix} s + 14 & 56 & 160 \\ 1 & s & 0 \\ 0 & -1 & s \end{bmatrix}^{-1} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + 0$$

$$\frac{Y(s)}{U(s)} = [0 \ 1 \ 0] \frac{1}{(s^3 + 14s^2 - 60) - (56s)} \begin{bmatrix} s^2 + 14s - 56 & -3 & -1 - s \\ -56s - 160 & s^2 + 14s & s + 4 \\ -160s & -160 & s^2 + 14s - 56 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + 0$$

$$\frac{Y(s)}{U(s)} = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \frac{s^2 + 14s - 56}{s^3 + 14s^2 - 56s - 160} \\ \frac{-56s - 160}{s^3 + 14s^2 - 56s - 160} \\ \frac{-160s}{s^3 + 14s^2 - 56s - 160} \end{bmatrix}$$

$$\frac{Y(s)}{U(s)} = G(s) = \frac{-56s - 160}{s^3 + 14s^2 - 56s - 160}$$