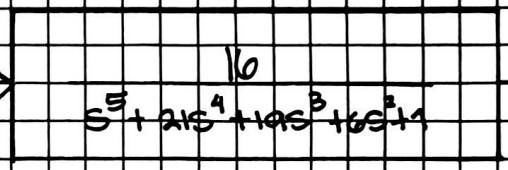
PROBLEM 2




SOLUTION

$$\frac{C(s)}{R(s)} = \frac{16}{s^5+21s^4+19s^3+6s^2+1}$$

$$\mathcal{L}\{s^5C(s)+21s^4C(s)+19s^3C(s)+6s^2C(s)+C(s)=K_0R(s)\}$$

$$\dddot{c}+21\ddot{c}+19\dot{c}+6\ddot{c}+c=16r$$

$$21\ddot{c}+19\dot{c}+7\ddot{c}+c=16r$$

$x_1 = c(t)$ $\quad \dot{x}_1 = \dot{c}(t) = x_2$ $\quad u_1 = r$

$x_2 = \dot{c}(t)$ $\quad \dot{x}_2 = \ddot{c}(t) = x_3$

$x_3 = \ddot{c}(t)$ $\quad \dot{x}_3 = \dddot{c}(t) = x_4$

$x_4 = \dddot{c}(t)$ $\quad \dot{x}_4 = \dddot{c}(t)$

$$\dot{x}_1 = 0x_1 + 1x_2 + 0x_3 + 0x_4 + 0u_1$$
$$\dot{x}_2 = 0x_1 + 0x_2 + 1x_3 + 0x_4 + 0u_1$$
$$\dot{x}_3 = 0x_1 + 0x_2 + 0x_3 + 1x_4 + 0u_1$$
$$\dot{x}_4 = \frac{-1}{21}x_1 + 0x_2 - \frac{7}{21}x_3 - \frac{19}{21}x_4 + \frac{16}{21}u_1$$

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\\ \dot{x}_4\end{bmatrix} = \begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0 & 0 & 0 & 1\\ -1/21 & 0 & -7/21 & -19/21\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\\ x_4\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 0\\ 16/21\end{bmatrix}\begin{bmatrix}u_1\end{bmatrix}$$

$y = c(t) = x_1$

$$y = \begin{bmatrix}1 & 0 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\\ x_4\end{bmatrix} + \begin{bmatrix}0\end{bmatrix}\begin{bmatrix}u_1\end{bmatrix}$$