WU TIANWEI

Question 1:

Solution:

$y(k) = c(k), x_1(k) = c(k), x_2(k) = c(k+1), x_3(k) = c(k+2)$

$\Rightarrow y(k) = x_1(k)$

$x_1(k+1) = c(k+1) = x_2(k)$

$x_2(k+1) = c(k+2) = x_3(k)$

$x_3(k+1) = c(k+3) = -7x_1(k) - 5x_2(k) - 3x_3(k) + 9u(k)$

$\Rightarrow A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -7 & -5 & -3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 9 \end{bmatrix}, \quad C = [1 \ 0 \ 0], \quad d = 0$

Therefore, the state-space representation for the system is

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -7 & -5 & -3 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 9 \end{bmatrix} u(k)$$

$$y(k) = [1 \quad 0 \quad 0] x(k)$$