L-4

$q_1(t) = y(t)$, $q_2(t) = \dot{y}(t)$

$q_3(t) = \ddot{y}(t)$

then $\dot{q}_1(t) = q_2(t)$, $\dot{q}_2(t) = q_3(t)$. $\dot{q}_3 \neq \dot{q}_4$

$\cancel{q_3(t) = -10}$

$N = 3$

$\Rightarrow \dot{q}_1(t) = q_2(t)$ –

On putting value in eqn

$$\dot{q}_N(t) = -a_N q_1(t) - a_{N-1} q_2(t) - \dots - a_1 q_N(t) + x(t)$$

$$\dot{q}_3(t) = -10 q_1(t) - 11 q_2(t) - 6 q_3(t) + 8x(t)$$

$$\begin{bmatrix} \dot{q}_1(t) \\ \dot{q}_2(t) \\ \dot{q}_3(t) \end{bmatrix} = \underbrace{\overbrace{\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -10 & -11 & -6 \end{bmatrix}}^{3\times 3}}_{A} \underbrace{\begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix}}_{q(t)} + \underbrace{\begin{bmatrix} 0 \\ 0 \\ 8 \end{bmatrix}}_{b} x(t)$$

$$y(t) = q_1(t) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} = q_1(t)$$

$$\therefore \dot{q}(t) = A q(t) + b x(t)$$

$$y(t) = C q(t)$$

$q_3(t) = -1$, $y(-1) = y(-2)$ L-5

$n < 0 \rightarrow n \geq 0$

State space Representation of Discrete LTI system

single - i/p discrete - time LTI system described by N order difference eqn ①

$n > 0$, initial cond. $y(-1), y(-2) \ldots y(-N)$

$$y(n) + a_1 y(n-1) + \ldots + a_N y(n-N) = x(n)$$

N values are required to specify the state of system at any time

$$q_1(n) = y(n-N)$$

$$q_2(n) = y(n-(N-1)) = y(n-N+1)$$

$$q_N(n) = y(N-1) \quad — ②$$

N = Period.

Then by ~~eqn ① and ②~~

$$q_1(n+1) = q_2(n)$$

$$q_2(n+2) = q_3(n)$$

$$q_3(n+3) =$$

$$\boxed{q_N(n+1) = -a_N q_1(n) - a_{N-1} q_2(n) + \ldots - a_1 q_N(n) + x(n)}$$

and $y(n) = -a_N q_1(n) - a_{N-1} q_2(n) - \ldots - a_1 q_N(n) + x(n)$

$$\begin{bmatrix} q_1(n+1) \\ q_2(n+1) \\ \vdots \\ q_N(n+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & \cdots & 0 \\ 0 & 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ -a_N & -a_{N-1} & -a_{N-2} & \cdots & -a_1 \end{bmatrix} \begin{bmatrix} q_1(n) \\ q_2(n) \\ \vdots \\ q_N(n) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} x(n)$$

State vector