$$\begin{bmatrix} v_1[n+1] \\ v_2[n+1] \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & 2\cos(2\pi k/N) \end{bmatrix} \begin{bmatrix} v_1[n] \\ v_2[n] \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} x[n] \tag{1}$$

$$\begin{bmatrix} v_1[n+2] \\ v_2[n+2] \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & 2\cos(2\pi k/N) \end{bmatrix} \begin{bmatrix} v_1[n+1] \\ v_2[n+1] \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} x[n+1] \tag{2}$$

$$\begin{bmatrix} v_1[n+2] \\ v_2[n+2] \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & 2\cos(2\pi k/N) \end{bmatrix} \begin{bmatrix} 0 & 1 \\ -1 & 2\cos(2\pi k/N) \end{bmatrix} \begin{bmatrix} v_1[n] \\ v_2[n] \end{bmatrix} + \begin{bmatrix} 0 & 1 \\ -1 & 2\cos(2\pi k/N) \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} x[n] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} x[n+1] \tag{3}$$

$$\begin{bmatrix} v_1[n+2] \\ v_2[n+2] \end{bmatrix} = \begin{bmatrix} -1 & 2\cos(2\pi k/N) \\ -2\cos(2\pi k/N) & 4\cos^2(2\pi k/N) - 1 \end{bmatrix} \begin{bmatrix} v_1[n] \\ v_2[n] \end{bmatrix} + \begin{bmatrix} 1 \\ 2\cos(2\pi k/N) \end{bmatrix} x[n] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} x[n+1] \tag{4}$$

$$\begin{bmatrix} v_1[n+2] \\ v_2[n+2] \end{bmatrix} = \begin{bmatrix} -1 & 2\cos(2\pi k/N) \\ -2\cos(2\pi k/N) & 4\cos^2(2\pi k/N) - 1 \end{bmatrix} \begin{bmatrix} v_1[n] \\ v_2[n] \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 2\cos(2\pi k/N) & 1 \end{bmatrix} \begin{bmatrix} x[n] \\ x[n+1] \end{bmatrix} \tag{5}$$