$$C(k) = \sum_{n=0}^{(N/2)-1} x(2n)W_{N/2}^{nk} \tag{6.24}$$

$$D(k) = \sum_{n=0}^{(N/2)-1} X(2n+1)W_{N/2}^{nk} \tag{6.25}$$

Then $X(k)$ in (6.23) can be written as

k $k < N/2 - 1$

$$X(k) = C(k) + W_N^k D(k) \tag{6.26}$$

Equation (6.26) needs to be interpreted for $k > (N/2) - 1$. Using the symmetry property (6.5) of the twiddle constant, $W^{k+N/2} = -W^k$,

$$X(k+N/2) = C(k) - W^k D(k) \qquad k = 0, 1, \ldots, (N/2)-1 \tag{6.27}$$

For example, for $N = 8$, (6.26) and (6.27) become

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$$X(k) = C(k) + W^k D(k) \qquad k = 0, 1, 2, 3 \tag{6.28}$$

$$X(k+4) = C(k) - W^k D(k) \qquad k = 0, 1, 2, 3 \tag{6.29}$$

Figure 6.8 shows the decomposition of an eight-point DFT into two four-point DFTs with the decimation-in-time procedure. This decomposition or decimation process is repeated so that each four-point DFT is further decomposed into two two-point DFTs, as shown in Figure 6.9. Since the last decomposition is $(N/2)$ two-point DFTs, this is as far as this process goes.

Figure 6.10 shows the final flow graph for an eight-point FFT using a decimation-in-time process. The input sequence is shown to be scrambled in Figure 6.10, in the same manner as the output sequence $X(k)$ was scrambled during the decimation-

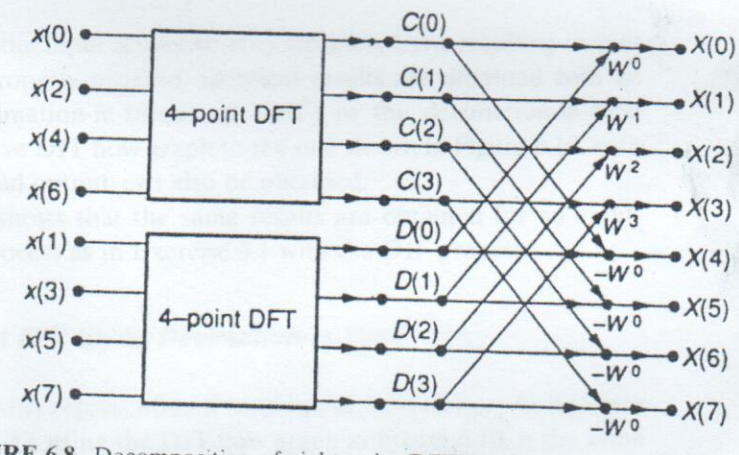

FIGURE 6.8. Decomposition of eight-point DFT into four-point DFTs using DIT.