

ECE 535 DIGITAL SIGNAL PROCESSING
Problem Set 7
 Spring 2001

Issued: Wednesday, March 21, 2001

Due: Tuesday, March 27, 2001

Reading in *Oppenheim and Schaffer*

Week of 3/27/01 — Chapter 8, Sections 8.0-8.7, 8.9
 Note that 8.8 will *NOT* be covered

Week of 4/3/01 — Chapter 9, Sections 9.0-9.6
 (We may start Ch. 9 on 3/27 and continue discussion after Exam 2)

EXAM ANNOUNCEMENT:

Exam 2 is **Tuesday, April 3**. This exam will cover material through the lecture on March 20, including problem sets 1-7 and Matlab assignments I-III. The exam will be closed book, but two $8\frac{1}{2}'' \times 11''$ sheets of notes (both sides) are allowed. Calculators are allowed, but probably won't be useful.

Problem 7.1

Figure 1 shows the DFS, $\tilde{X}_1[k]$, of a periodic sequence $\tilde{x}_1[n]$ that has period $N = 4$. Figure 2 shows the periodic sequence $\tilde{x}_2[n]$ (period $N = 4$).

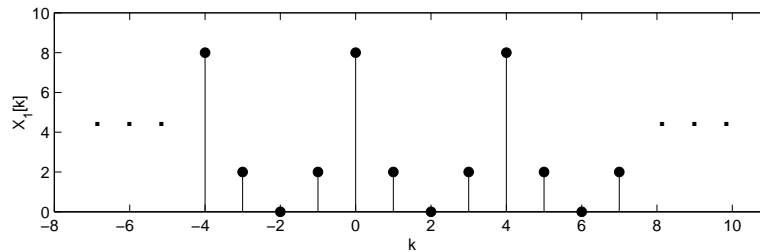


Figure 1: DFS of sequence $\tilde{x}_1[n]$

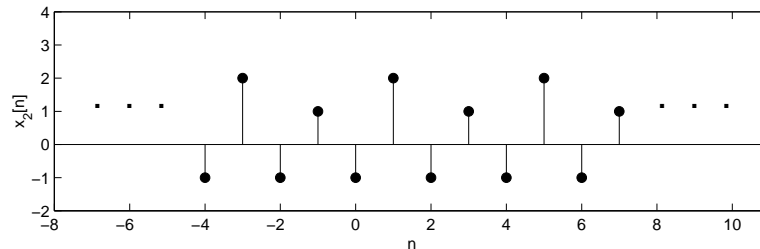


Figure 2: Sequence $\tilde{x}_2[n]$

- (a) Determine the periodic sequence $\tilde{x}_1[n]$.
- (b) Find the sequence $\tilde{y}_1[n]$ whose DFS is equal to the product of the DFS of $\tilde{x}_1[n]$ and the DFS of $\tilde{x}_2[n]$, i.e., $\tilde{Y}_1[k] = \tilde{X}_1[k]\tilde{X}_2[k]$.
- (c) Suppose that $\tilde{x}_1[n]$ is the input to a filter with frequency response $h[n] = \left(\frac{1}{2}\right)^n u[n]$. What is the output of the filter? (An analytical expression should be fairly easy to obtain.)

Problem 7.2

Oppenheim and Schaffer, problem 8.28

Problem 7.3

Oppenheim and Schaffer, problem 8.29

Problem 7.4

Compute the DFT of each of the following finite-length sequences considered to be of length N (where N is even):

(a) $x[n] = \delta[n]$

(b) $x[n] = \delta[n - n_0] \quad 0 \leq n_0 \leq N - 1$

(c) $x[n] = \begin{cases} 1, & n \text{ even}, \quad 0 \leq n \leq N - 1 \\ 0, & n \text{ odd}, \quad 0 \leq n \leq N - 1 \end{cases}$

(d) $x[n] = \begin{cases} 1, & 0 \leq n \leq N/2 - 1 \\ 0, & N/2 \leq n \leq N - 1 \end{cases}$

(e) $x[n] = \begin{cases} a^n, & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}$