

GEORGIA INSTITUTE OF TECHNOLOGY  
School of Electrical and Computer Engineering

**ECE 4270**  
Fundamentals of Digital Signal Processing

Assigned: Thursday, Sept 3, 2009  
Due: Thursday, Sept. 10, 2009

### Problem Set #3

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**Reading:** Read the following sections from Oppenheim and Schaffer:  
Chapter 2, Sections 2.7–2.10, pp. 48–70.

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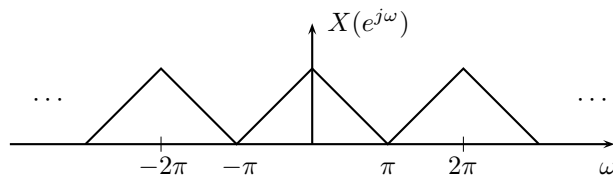
**Problem 3.1:** Work Oppenheim and Schaffer Problem 2.41 on page 80.

**Problem 3.2:** Work Oppenheim and Schaffer Problem 2.67 on page 87.

**Problem 3.3:** Work Oppenheim and Schaffer Problem 2.84 on page 91.

**Problem 3.4:** Work Oppenheim and Schaffer Problem 2.85 on page 91.

**Problem 3.5:** Let  $x[n]$  and  $X(e^{j\omega})$  represent a sequence and its Fourier transform, respectively. Determine, in terms of  $X(e^{j\omega})$ , the transforms of  $y_s[n]$ ,  $y_d[n]$  and  $y_e[n]$ . In each case sketch  $Y(e^{j\omega})$  for  $X(e^{j\omega})$  as shown in the following figure.



(a) Sampler:

$$y_s[n] = \begin{cases} 0, & n \text{ even} \\ x[n], & n \text{ odd} \end{cases}$$

Note that  $y_s[n] = \frac{1}{2}\{x[n] - (-1)^n x[n]\}$  and  $-1 = e^{j\pi}$ .

(b) Compressor:

$$y_d[n] = x[2n + 1]$$

(c) Expander:

$$y_e[n] = \begin{cases} 0, & n \text{ even} \\ x[\frac{n-1}{2}], & n \text{ odd} \end{cases}$$

**Problem 3.6 (Optional):** Work Oppenheim and Schaffer Problem 2.44 on page 80.