University of Notre Dame
Department of Electrical Engineering
November 9, 2007
EE 67003: Advanced Digital Signal Processing
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Homework 5

Due: November 13, 2007, 12:15am (end of class)

Reading: Textbook sections 11.1-11.5

Problems from textbook:

1. Problem 11.1
2. Problem 11.3
3. Problem 11.10

Problem 1:

Consider the system shown in Fig. 1. For each of the following input signals $x(n)$, indicate whether the output $y(n) = x(n)$.

(a) $x(n) = \cos(\pi n/4)$

(b) $x(n) = \cos(\pi n/2)$

(c) $x(n) = (\frac{\sin(\pi n/8)}{\pi n})^2$

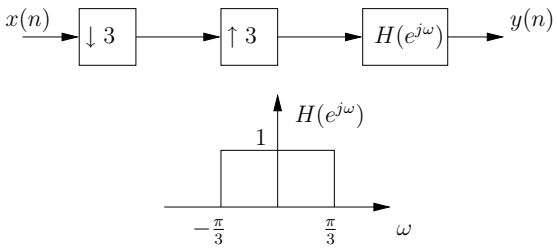

Figure 1:

Problem 2:

Let $X(z)$ be the polynomial

$$X(z) = 1 + 2z^{-1} + 3z^{-2} + z^{-3}.$$

(a) Give an expression for $X(z^2)$ and $\mathcal{Z}^{-1}(X(z^2))$

(b) Give an expression for $X(-z)$ and $\mathcal{Z}^{-1}(X(-z))$

(c) Give an expression for $X(-z^2)$ and $\mathcal{Z}^{-1}(X(-z^2))$

(d) Give an expression for $X(z) \cdot X(-z)$. Are there any characteristics?

(e) Determine the type-1 polyphase decomposition of $X(z)$ for $M = 2$.

(f) Determine the type-2 and type-3 polyphase decomposition of $X(-z)$ for $M = 2$.

(g) Determine the impulse responses of the systems in Fig. 2 with $H(z) = 1 + 2z^{-1} + z^{-2}$.

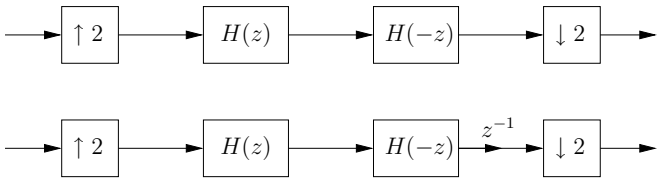

Figure 2: