Midterm Exam — ECE 251C Fall 2012, Nguyen

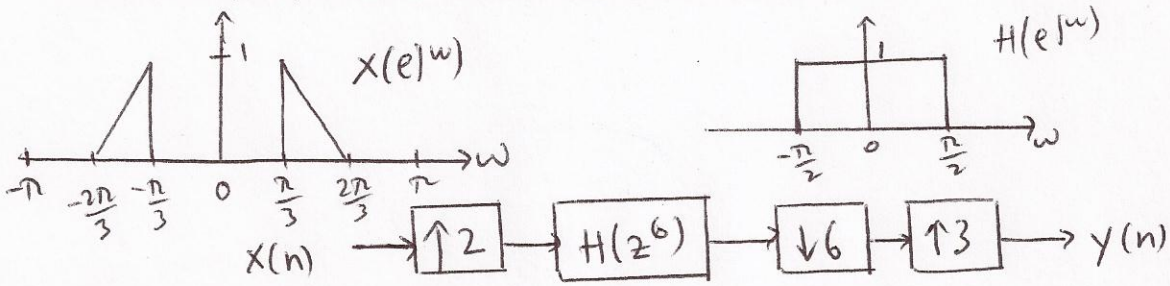
Problem 1. (25pt) Consider the following LTI system $H(z)$ with input-output relation:

$$2y(n) = 2x(n) + y(n-1) + 2y(n-2) - y(n-3)$$

a. Find the two polyphases $H_{even}(z)$ and $H_{odd}(z)$, i.e., $H(z) = H_{even}(z^2) + z^{-1}H_{odd}(z^2)$

b. Find the three polyphases $E_0(z), E_1(z), E_2(z)$, i.e., $H(z) = E_0(z^3) + z^{-1}E_1(z^3) + z^{-2}E_2(z^3)$

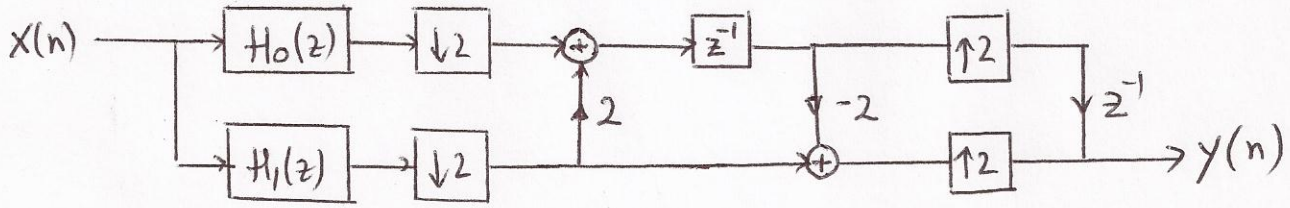
Problem 2. (25pt) Consider the following multirate system:



a. Find $Y(z)$ in terms of $X(z)$ and $H(z)$

b. Sketch $|Y(e^{j\omega})|$

Problem 3. (50pt) Consider the following two-channel filter bank:



a. Find the polyphase matrix $\mathbf{F}_p(z)$

b. Find the synthesis filters $F_0(z)$ and $F_1(z)$.

c. Find the PR analysis filters $H_0(z)$ and $H_1(z)$ by inverting $\mathbf{F}_p(z)$.

d. Find the PR analysis filters $H_0(z)$ and $H_1(z)$ by aliasing condition and halfband condition.

e. Find the delay L, i.e., $y(n) = x(n-L)$.