ENEE 630 Fall 2012 Homework 1[1]

Material covered: Basic multirate operators and interconnection of building blocks.

Problem 1 For the system in Fig. P-1, find an expression for $y(n)$ in terms of $x(n)$. Simplify the expression as best as you can.

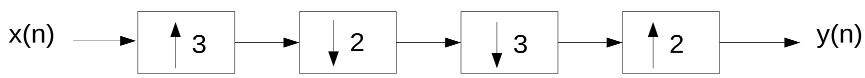

Figure : P-1

Problem 2 Show that the two systems shown in Fig. P-2(a) (where k is some integer) are equivalent (that is, $y_0(n) = y_1(n)$) when $h_k(n) = h_0(n)cos(2\pi kn/L)$.

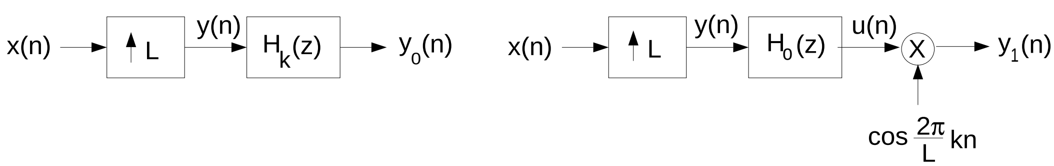

Figure : P-2(a)

This is a structure where filtering followed by cosine modulation has the same effect as filtering with the cosine modulated impulse response. (This is not true in all situations; see next problem). Now consider the example where $L = 5$, and $k = 1$. Let $X(e^{j\omega})$ and $H_0(e^{j\omega})$ be as sketched in Fig. P-2(b). Give sketches of $Y(e^{j\omega})$, $Y_0(e^{j\omega})$ and $U(e^{j\omega})$.

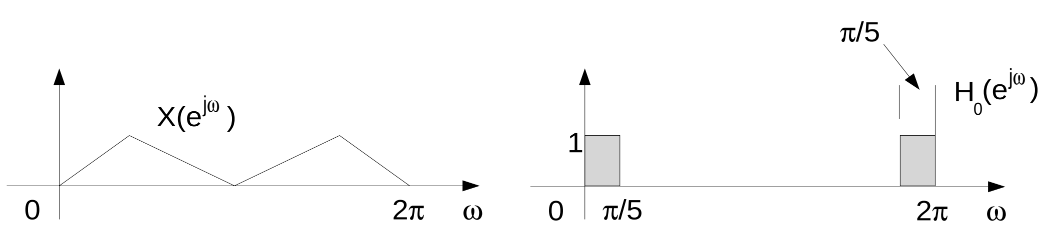

Figure : P-2(b)

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Problem 3 Show that the two systems shown in Fig.P-3 are no equivalent, that is, $y_0(n)$ and $y_1(n)$ are not necessarily the same, even if $h_k(n) = h_0(n)cos(2\pi kn/L)$.

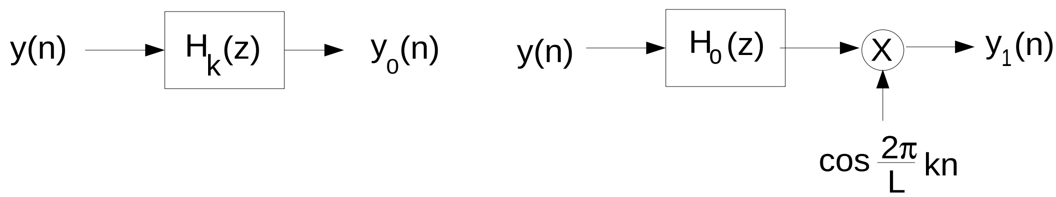

Figure : P-3

Problem 4 Consider a sequence $x(n)$ with $X(e^{j\omega})$ as shown in Fig. P-4(a).

Suppose we generate the sequences $y(n)$ and $s(n)$ from $x(n)$ as in Fig. P-4(b), where

$$H(e^{j\omega}) = \begin{cases} 1 & for\ |\omega| < \pi/2 \\ 0 & for\ \pi/2 \leq |\omega| \leq \pi \end{cases}$$

Plot the quantities $Y(e^{j\omega})$ and $S(e^{j\omega})$.

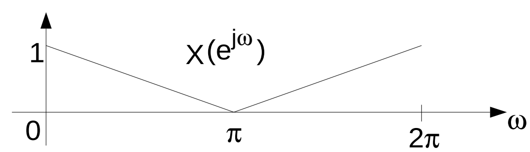

Figure: P-4(a)

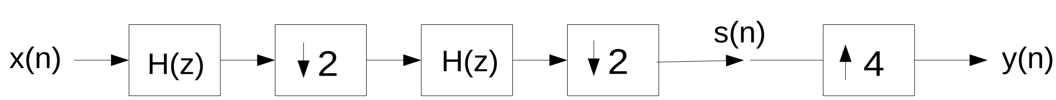

Figure: P-4(b)