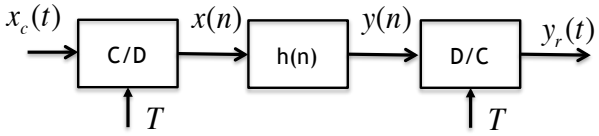
Hw4

The following system is used in the first three problems.



1. Consider the following sampling rate conversion system with $L = 3$ and $M = 2$.
   (a) Find an appropriate choice of $H(e^{j\omega})$.
   (b) Draw an $X(e^{j\omega})$ of your choice and plot the corresponding $X_e(e^{j\omega})$.
   (c) Plot $Y(e^{j\omega})$ and $Y_d(e^{j\omega})$ for the input $X(e^{j\omega})$ in (b).

2. Let $x(n)$ be a sequence obtained by sampling a music signal $x_c(t)$ with sampling period T and there is no aliasing in sampling. Sampling rate conversion is applied on $x(n)$ using the system in the above figure.
   (a) Suppose we would like to listen to the music by passing $y_d(n)$ through a D/C system. How to choose the sampling period for the D/C?
   (b) How is the D/C output $Y_r(j\Omega)$ related to $X_c(j\Omega)$ in (a)?

3. Consider the sampling rate conversion system with $M = 1$.
   (a) Find $h(n)$ so that $y(Ln + 1) = y(Ln + 2) = \cdots = y(Ln + L - 1) = x(n)$ for all n.
   (b) Suppose $L = 2$. Find $h(n)$ so that $y(2n + 1) = 1/2\big(x(n) + x(n + 1)\big)$ for all n.
   (c) For a general L, find $h(n)$ so that the values of $y(Ln+1), y(Ln+2), \cdots, y(Ln+L-1)$ lie on the lines formed by $y(Ln)$ and $y(Ln + L)$.

4. Consider the following two systems. How is $y_1(n)$ related to $y_2(n)$?