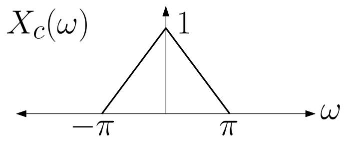
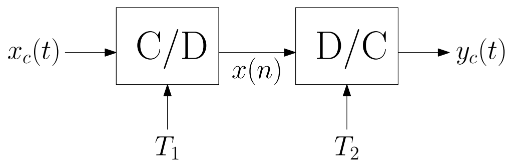
BYM 510E – Homework 2

Due 10.03.2011

1. Let $x_c(t)$ be a continuous-time bandlimited signal whose Fourier Transform is :



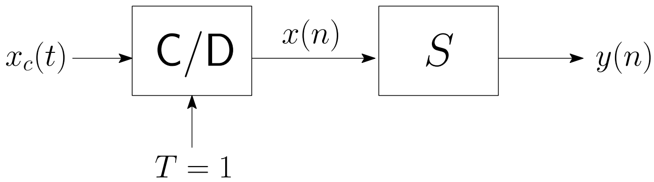
Consider the system composed of a C/D converter followed by a D/C converter.



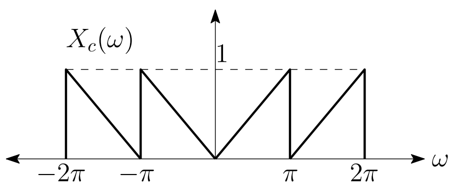
(a) For a C/D sampling period of 2 sec ($T_1 = 2$), find $X(e^{j\omega})$.

(b) For a D/C sampling period of $T_2 = 1$ sec, determine $Y_c(\omega)$, the Fourier transform of $y_c(t)$.

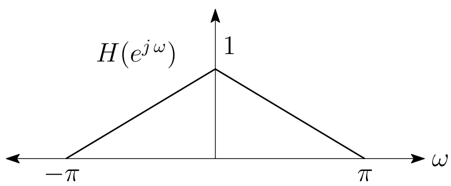
2. Consider the following system



which samples a continuous-time signal and then applies an LTI system (denoted by S) to the resulting discrete-time signal $x(n)$. Suppose that $X_c(\omega)$, the Fourier transform of $x_c(t)$ is given as



Suppose also that $H(e^{j\omega})$, the frequency response of the system S is given by,



(a) Determine and sketch $X(e^{j\omega})$, the DTFT of $x(n)$.

(b) Determine and sketch $Y(e^{j\omega})$, the DTFT of $y(n)$.

3. Compute the DFTs of the following length-N signals (where N is even).

   (a) $x(n) = \delta(n)$ for $0 \le n \le N-1$

   (b) $x(n) = \delta(n-m)$ for $0 \le n \le N-1$, where $0 \le m \le N-1$

   (c) $x(n) = \begin{cases} 1 & \text{if } n \text{ is even} \\ 0 & \text{if } n \text{ is odd} \end{cases}$

   (d) $x(n) = \begin{cases} 0 & \text{if } n \text{ is even} \\ 1 & \text{if } n \text{ is odd} \end{cases}$

   (e) $x(n) = \begin{cases} 1 & \text{if } 0 \le n \le N/2-1 \\ 0 & \text{if } N/2 \le n \le N-1 \end{cases}$

   (f) $x(n) = a^n$ for $0 \le n \le N-1$

   (g) $x(n) = \exp\left(j \frac{2\pi}{N}\, m\, n\right)$ for $0 \le n \le N-1$, where $0 \le m \le N-1$

   (h) $x(n) = \sin\left(\frac{2\pi}{N}\, m\, n\right)$ for $0 \le n \le N-1$, where $0 \le m \le N-1$

4. Let $x(n)$ be a length-N signal for N even, and let $X(k)$ denote its length-N DFT. Suppose we set $y(n) = X(n)$ for $0 \le n \le N-1$. Express $y(n)$ in terms of $x(n)$.