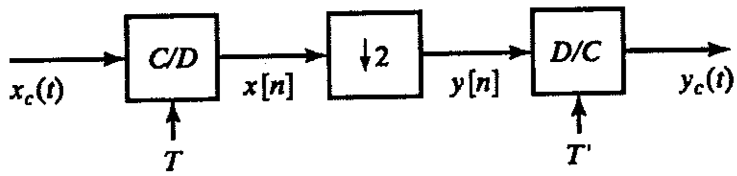
Digital Signal Processing 資格考

May 2008

1. **(20%)** Determine if the systems described by the following input-output equations are (1) linear, (2) stable, and (3) causal.
   (a) $y[n] = 3x[n]+5$
   (b) $y[n] = x[n^2]$
   Justify your answer.

2. **(20%)** In the following figure, $x[n] = x_c(nT)$ and $y[n] = x[2n]$
   (a) Assume that $x_c(t)$ has a Fourier transform such that $X_c(j\Omega) = 0,\ |\Omega| > 2\pi(100)$. What value of T is required so that
   $$X(e^{j\omega}) = 0,\quad \frac{\pi}{2} < |\omega| \le \pi ?$$
   (b) How should T' be chosen so that $y_c(t) = x_c(t)$?



3. **(20%)** Consider a right-sided sequence x[n] with z-transform
   $$X(z) = \frac{2z^2 - z}{2z^2 + \frac{3}{2}z + \frac{1}{4}}$$
   Determine the inverse z-transform using each of the following methods

4. **(20%)** Consider a stable linear time-invariant system with input x[n] and output y[n]. The input and output satisfy the difference equation.
   $$y[n-1] - \frac{5}{2}y[n] + y[n+1] = x[n]$$
   (a) Plot the poles and zeros in the z-plane.
   (b) Find the impulse response h[n].

5. **(20%)** Let $X(e^{j\omega})$ denote the Fourier transform of the sequence $x[n] = (\frac{1}{2})^n u[n]$. Let $y[n]$ denote a finite-duration sequence of length 10; i.e., $y[n] = 0,\ n < 0$, and $y[n] = 0,\ n \ge 10$. The 10-point DFT of $y[n]$, denoted by Y[k], corresponds to 10 equally spaced samples of $X(e^{j\omega})$; i.e., $Y[k] = X(e^{j2\pi k/10})$. Determine y[n].