8 points 1. For each of the following systems, determine and justify whether the system is (1) stable, (2) causal, (3) linear, and (4) time invariant.

(a) $y[n] = x[-n+2]$

(b) $y[n] = \text{Trun}\{x[n]\}$, where $\text{Trun}\{x[n]\}$ denotes the integer part of $x[n]$, obtained by truncation

8 points 2. Determine the z-transform of the following signals and sketch the corresponding pole-zero plots

(a) $x[n] = (1+n)u[n]$

(b) $x[n] = (-1)^n 2^{-n} u[n]$

8 points 3. Determine all possible signals $x[n]$ associated with the z-transform

$$X(z) = \frac{5z^{-1}}{(1-2z^{-1})(3-z^{-1})}$$

8 points 4. The system shown in Figure 1 is used to process continuous-time signals in the discrete-time domain. The continuous-time signal $x_c(t)$ is bandlimited to $|\Omega| < \Omega_0$, and the sampling rate used in both the C/D and D/C is $T = \pi/\Omega_0$. The discrete-time filter has frequency response

$$H(e^{jw}) = \frac{1}{T}\left(e^{jw/2} - e^{-jw/2}\right), \qquad |w| \leq \pi.$$

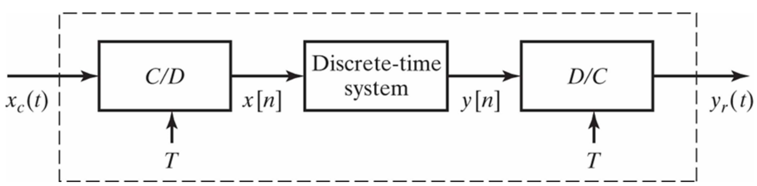

Figure 1: Discrete-time processing of continuous-time signals.

(a) Find the effective continuous-time frequency response $H_{\text{eff}}(j\Omega)$ of the end-to-end system.

(b) Find $x[n]$, $y[n]$, and $y_r(t)$, when the input signal is $x_c(t) = \sin(\Omega_0 t)/(\Omega_0 t)$.

8 points 5. The system shown in Figure 2 is used to change the sampling rate of a discrete-time signal by a non-integer value. The input signal is $x[n] = \sin(2\pi n/3)/\pi n$, and the values of L and M are 6 and 7, respectively.

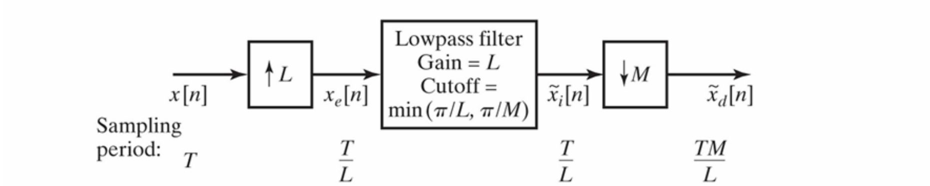

Figure 2: Discrete-time processing of continuous-time signals.

(a) Sketch the spectrum of $x[n], x_e[n], \tilde{x}_i[n]$, and $\tilde{x}_d[n]$.

(b) Determine the output $\tilde{x}_d[n]$.

Good luck ...