EE 451 - Exam 2

October 15, 1999

Name: ____

Closed book. You may use a calculator and one page of notes. Show all work. Partial credit will be given. No credit will be given if an answer appears with no supporting work.

1. Consider the following z-transform of a stable system:

$$H(z) = \frac{2}{1 - \frac{1}{2}z^{-1}} + \frac{3}{1 + 3z^{-1}}$$

(a) What is the region of convergence for $H(z)$?

(b) Is the impulse response $h[n]$ a right-handed sequence, a left-handed sequence, or a two-sided sequence?

(c) Find $h[n]$.

2. When the input to a system is

$$x[n] = \left(\frac{1}{2}\right)^n u[n] + 2^n u[-n-1]$$

the output is

$$y[n] = 6\left(\frac{1}{2}\right)^n u[n] - 6\left(\frac{3}{4}\right)^n u[n]$$

(a) Find $X(z)$ and its region of convergence.

(b) Find $Y(z)$ and its region of convergence.

(c) Find $H(z)$ and its region of convergence.

(d) Is the stable? Is it causal?

(e) Write the difference equation which characterizes the system.

3. A continuous-time signal $x_c(t) = \sin(480\pi t) + 3\sin(720\pi t)$ is sampled at 600 times per second.

   (a) Determine the minimum sampling rate to avoid aliasing.

   (b) What are the frequencies, in radians/sample, in the resulting discrete-time signal $x[n]$? Be sure to normalize these frequencies so they are between $-\pi$ and π.

   (c) If $x[n]$ is passed through an ideal D/C converter (D/A converter with ideal reconstruction filter), what is the reconstructed signal $y_c(t)$?

4. Consider the system shown in Figure 4.1 below. The discrete-time LTI system in Figure 4-1 has the frequency response shown in Figure 4-2. The input to this system is the band-limited signal whose Fourier transform is shown in Figure 4-3.

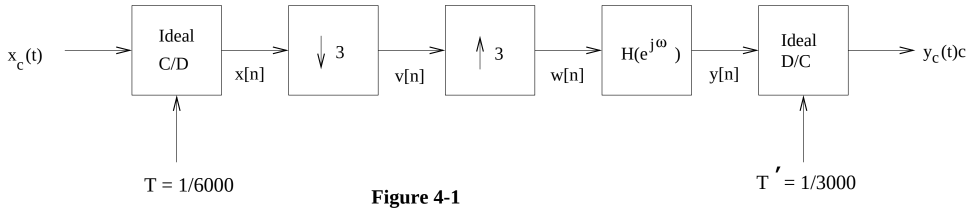

Figure 4-1

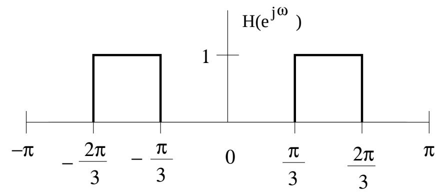

Figure 4-2

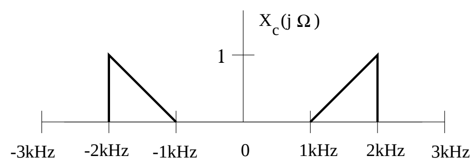

Figure 4-3

(a) Sketch the Fourier transform $X(e^{j\omega})$.

(b) Sketch the Fourier transform $V(e^{j\omega})$.

(c) Sketch the Fourier transform $W(e^{j\omega})$.

(d) Sketch the Fourier transform $Y(e^{j}\omega)$.

(e) Sketch the Fourier transform $Y_c(j\Omega)$.