October 30, 1998 **Name:___________________**

EE 438 **Exam No. 2** **Fall 1998**

- You have 50 minutes to work the following four problems.
- Be sure to show all your work to obtain full credit.
- The exam is closed book and closed notes.
- Calculators are permitted.

1. (25 pts.) Consider the causal LTI system described by the difference equation

$$y[n] = x[n] + y[n-1]$$

   a. (14) Use the ZT to find the impulse response h[n] for this system.
   b. (10) Use the ZT to find the response y[n] of the system to the input x[n] = u[n].
   c. (1) Is this system BIBO stable?

1. (continued)

2. (25 pts.) Let x[n], n = 0,…,N-1 be an N point signal with N point DFT $X^N[k],\ k = 0,\ldots,\ N-1$. Now generate a new 2N point signal y[n], n = 0,…, 2N-1 by simply repeating x[n], i.e.

$$y[n] = \begin{cases} x[n], & 0 \le n \le N-1 \\ x[n-N], & N \le n \le 2N-1 \end{cases}$$

Find a simple expression for the 2N point DFT $Y^{2N}[k],\ k = 0,\ldots,2N-1$ in terms of $X^N[k],\ k = 0,\ldots,\ N-1$.

2. (continued)

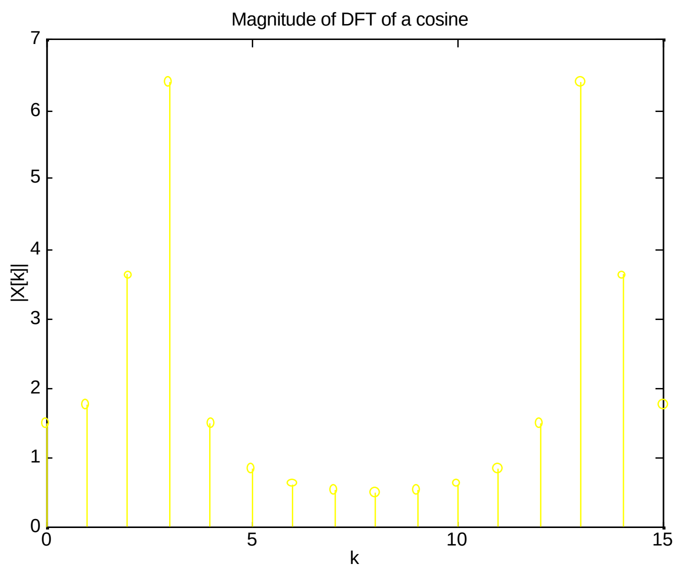
3. (25 pts.) The plot below shows the magnitude of the DFT of a cosine x[n] which was obtained by sampling an analog waveform at a 10kHz rate.

   a. (10) Estimate the digital frequency ω_d in radians/sample of this signal.

   b. (5) Assuming that the analog waveform was not undersampled, what is the corresponding analog frequency f_a?

   c. (5) Find the digital frequency ω_d' closest to ω_d for which there is no leakage or picket fence effect.

   d. (5) Sketch approximately what the magnitude of the DFT would look like in this case.



3. (continued)

4. (25 pts.) Derive the decimation in time fast Fourier transform algorithm for a 6 point DFT. Show a complete flow diagram, including all twiddle factors for your FFT.

4. (continued)

1.	________
2.	________
3.	________
4.	________
Total	________