**ASSIGNED:** Mar. 24, 2006. **READ:** Part 7 of Official Lecture Notes (available on-line).
**DUE DATE:** Mar. 31, 2006. **TOPICS:** z-transforms; inverse z-transforms; applications.

Show work on separate sheets of paper. Include all hand and Matlab plots and code.

[15] 1. Compute the z-transforms of:
[5] (a) $\{\underline{2}, 7, 1, 8\}$. [5] (b) $\{\underline{2}, 8, 1\} + 2u[n-1]$. [5] (c) $2^n u[n] + 3^n u[n]$.
Write each answer in the form of a rational function (a ratio of two polynomials in $z$).

[25] 2. Compute the inverse z-transforms of:
[5] (a) $(8z^2 + 2z + 4)/z^2$. [5] (b) $(z-1)/(z^2 - 5z + 6)$. [15] (c) $2z/(z^2 - 2z + 2)$.

[25] 3. An LTI system has impulse response $2^n u[n] + 4^n u[n]$. Compute the following:
[5] (a) $H(z)$ [5] (b) DIFFERENCE EQUATION [5] (c) FREQUENCY RESPONSE [5] (d) ZEROS POLES [5] (e) RESPONSE TO $\{\underline{1}, -4\}$

[25] 4. An LTI system has DIFFERENCE EQUATION $y[n] - y[n-1] - y[n-2] = x[n-1]$. Compute:
[5] (a) $H(z)$ [5] (b) FREQUENCY RESPONSE (c) [5] ZEROS POLES [5] (d) IF BIBO STABLE (e) [5] IMPULSE RESPONSE

[10] 5. *Downsampling: Another type of signal compression:*
Often a signal can be low-pass filtered without losing significant content.
For example, voice signals can be understood from their lowest 4000 Hz
(voices on analog telephones are bandlimited to 4000 Hz to save bandwidth).

The bit rate of an oversampled signal can be halved using *downsampling*.
*Downsampling* (also called subsampling or decimation) is performed by
simply tossing out every other sample, i.e., keep $x[n]$ only if time $n$ is even.
Note downsampling is equivalent to cutting the original sampling rate in half.
Of course, we need to be able to recover the missing samples by interpolation.

The following two lines of Matlab illustrate this. **Explain what it does.**

```
load handel;FX=fft(y(1:65536));FX(16385:49153)=zeros(1,32769);
X=ifft(FX);Y=X(1:2:65536);Z=interpft(Y,65536);
```

Compare Z and X.

"An elephant is a mouse built to goverment specifications."