Due Tuesday, 20 July 2004 at 4:00 PM

ECE 438 **Assignment No. 8** **Summer 2004**

1. Suppose the input to a uniform quantizer is well-characterized by a Gaussian random variable with mean=0 and variance=25. Using the assumptions and relationships derived in class...

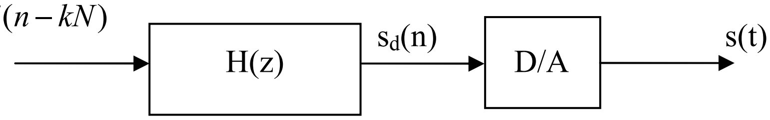
   a. Find the minimum and maximum quantization levels to achieve an approximately 3 in 1000 chance of overload.
   (i.e. $\Pr\{x(nT)<l_{min}$ or $x(nT)>l_{max}\}=.003$.

   b. How many bits are required for the quantizer to achieve a SQNR of at least 90dB?

   c. What is the resolution (step-size) of this quantizer?

2. The following system is used to digitally synthesize the phoneme IY. The first three formant frequencies are 270 Hz, 2290 Hz, and 3010 Hz, and the pitch frequency is 125 Hz.

$$e(n)=\sum_{k=-\infty}^{\infty}\delta(n-kN)$$



(assume ideal D/A)

The system operates at a data rate of 10 kHz, and the transfer function of the filter is

$$H(z)=\frac{z^6}{[z^2-1.8\cos(\theta_1)z+.81][z^2-1.2\cos(\theta_2)z+.36][z^2-0.8\cos(\theta_3)z+.16]}$$

   a. Determine the required value of N for the excitation e(n).

   b. Determine the appropriate values of θ_1 , θ_2 , and θ_3 in the denominator of the transfer function.

   c. Sketch approximately what S(f), the CTFT of s(t), would look like.

Hints: A similar filter was analyzed in Lab 5, week 1.
Remember how the frequency response $H(e^{j\omega})$ depends on the pole locations (angle and distance from the unit circle). Then relate this to the CTFT of s(t).