Due Friday, 9 July 2004 at 4:00 PM

ECE 438 — Assignment No. 6 — Summer 2004

1. Consider the *notch filter* with the following transfer function:

$$H(z) = \frac{(z - e^{j\omega_o})(z - e^{-j\omega_o})}{(z - re^{j\omega_o})(z - re^{-j\omega_o})} G$$

where r and ω_o are real constants such that $0 < r < 1$ and $0 < \omega_o < \pi$, and G is a constant which specifies the *gain* of the filter.

   a. Draw a pole-zero diagram for H(z).
   b. Determine an expression for the gain G such that the filter has a DC response of 1 (i.e. $H(e^{j0})=1$). Simplify this into a real-valued expression.
   c. Use Matlab to plot the magnitude response $|H(e^{j\omega})|$ for $-\pi < \omega < \pi$. Generate 3 plots using r={0.90, 0.95, 0.99} with $\omega_o=\pi/2$. Use the gain that you determined in part b.
   d. Determine a linear constant-coefficient difference equation which implements this system. All the coefficients should be real-valued.

2. Compute the inverse Z-transform of the functions below. Show your work. You may use (only) the transform properties/pairs that were given in class.

   a. $X(z) = \dfrac{z^{-4}}{4z - 1}$ *where* $ROC = \left\{ |z| > \dfrac{1}{4} \right\}$

   b. $X(z) = \dfrac{1}{(z - a)^2}$ *where* $ROC = \{ |z| > |a| \}$

   Hint for b: Differentiate $\dfrac{1}{z - a}$ and use the given properties.