ENEE 425

Section 0101 Fall 2004

Homework #6

1) For each of the following functions in z space, compute the inverse Z transform $x[n]$.

a) $X(z) = 3$

b) $X(z) = \frac{z}{3}$

c) $X(z) = 5z^{-2}$

d) $X(z) = \frac{1}{1 - z^{-1}/4}$ for $|z| > 1/4$

e) $X(z) = \frac{4}{3 + z^{-1}}$ for $|z| > 1/3$

f) $X(z) = \frac{z}{1 - 2z^{-1}}$ for $|z| > 2$

2) For each of the following functions in z space, compute the inverse Z transform $x[n]$.

a) $X(z) = \sin(c/z)$

b) $X(z) = \sin(z/c)$

3) For each of the following systems: list its zeros and poles (and their order); compute its stability; compute the impulse response $h[n]$; compute the Fourier Transform $H(e^{j\omega})$; characterize (and justify your answer) the system as a frequency-selective filter (e.g. high pass, low pass, all pass, band pass, etc.).

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

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

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

4) $X(z)$ has a double zero at $z=0$ and two simple poles at $z=-1/3$ and $z=1/5$. Using the method of partial fractions, calculate $x[n]$ (up to overall scale), for the following ROCs:

a) ROC = $\{z : |z| > 1/3\}$

b) ROC = $\{z : 1/5 < |z| < 1/3\}$

c) ROC = $\{z : |z| < 1/5\}$

5) For each of the following causal systems, compute the Z transform of the impulse response, its ROC, and its zeros and poles. Which systems are stable, and why? Is the impulse response of each system right-sided, left-sided, both-sided, or finite-duration? Explain.

a) $y[n]-\frac{1}{4}y[n-1]-\frac{1}{8}y[n-2]=2x[n]-\frac{1}{6}x[n-1]$

b) $y[n]+\frac{3}{4}y[n-1]+\frac{1}{8}y[n-2]=2x[n]-\frac{2}{3}x[n-1]$

c) $y[n]-\frac{3}{4}y[n-1]-\frac{1}{4}y[n-2]=2x[n]+\frac{4}{3}x[n-1]$

6) For each of the following sequences, compute the Z transform $X(z)$.

a) $x[n]=n\left(\frac{3}{4}\right)^{n}u[-n]$

b) $x[n]=-n\left(\frac{3}{4}\right)^{-n}u[n]$

7) For each of the following causal systems, list its zeros and poles (and their order), its ROC and its stability:

a) $H_1(z)=\dfrac{\frac{3}{2}-z^{-1}}{1-\frac{4}{3}z^{-1}+\frac{1}{3}z^{-2}}$

b) $H_2(z)=\dfrac{-\frac{1}{2}z^{-1}}{1-\frac{4}{3}z^{-1}+\frac{1}{3}z^{-2}}$

c) $H(z)=H_1(z)+H_2(z)$