ASSIGNED: Feb. 07, 2013. **READ:** Sects. 4.2 & 4.3 (skip 4.2.7-4.2.8: $\mathcal{Z}^+$ *much* easier).
DUE DATE: Feb. 14, 2013. **TOPICS:** Difference equations and transfer functions.

Please $\boxed{\text{box}}$ your answers. Show your work. Turn in all Matlab plots and Matlab code.

[20] 1. Solve y[n]–5y[n–1]+6y[n–2]=4u[n]=step with initial conditions y[–1]=y[–2]=1 by:

- [10] (a) Using the one-sided z-transform $\mathcal{Z}^+$ and computing the *causal* $\mathcal{Z}^{-1}$.
- [10] (b) Using Matlab: `Y(1)=1;Y(2)=1;for I=3:7;Y(I)=4+5*Y(I-1)-6*Y(I-2);end;Y`
  Include your Matlab output. Your answers should agree for $n \leq 5$.

[20] 2. The step response (to u[n]) of an LTI system is known to be 2u[n]+$(-2)^n$u[n].

- [5] (a) Compute the transfer function H(z). [5] (b) Compute the poles and zeros.
- [5] (c) Compute the impulse response h[n]. [5] (d) Compute the difference equation.

[20] 3. An LTI system has zeros $\{3, 4\}$ and poles $\{1, 2\}$. The transfer function=6 at z=0.

- [5] (a) Compute the transfer function H(z). [5] (b) Compute response to x[n]=$\{\underline{1}, -3, 2\}$.
- [5] (c) Compute the impulse response h[n]. [5] (d) Compute the difference equation.

[20] 4. We wish to find the **stable** *inverse* system for y[n]=x[n]–7x[n–1]+12x[n–2].

- [05] (a) Explain why we can't use y[n]–7y[n–1]+12y[n–2]=x[n] as the inverse system.
- [05] (b) Determine the stable inverse system. HINT: It is not causal but decays rapidly.
- [10] (c) Truncate the anticausal part for $n < -10$. Delay the result by 10 to get g[n].
  Compute `conv(G,[1,-7,12]`. Show you get very close to $\delta[n-10]$. Turn in this:
  Stem-plot your output, omitting the first two and last two values (end effects).

[20] 5. Download `p4.mat`. In Matlab, type >>`load p4.mat` to get the sampled signal `Y`.

- [5] (a) Listen to `Y` using `soundsc(X,24000)`. Describe what you hear.
- [5] (b) `Y` was produced from a signal `X` using the *reverbing* system
  y[n]=x[n]+(0.8)x[n–3(1024)]+$(0.8)^2$x[n–6(1024)]+$(0.8)^3$x[n–9(1024)]+. . .
  Compute the transfer function. HINT: 1+r+r^2+r^3+. . .=$\frac{1}{1-r}$ if $|r| < 1$.
  Rule: If you have no idea what to do, start by taking the z-transform.
- [5] (c) Compute the inverse filter for this system. It should be an MA system.
- [5] (d) Use `filter` to implement the inverse filter and recover the signal `X`.
  You may use three nonzero numbers in `filter`, and a *lot* of zeros.
  No Matlab output needed here; just specify the full `filter` command you used.

Excuse heard in a genetic engineering class: "My homework ate the dog."