**ASSIGNED:** Feb. 05, 2015. **READ:** Sects. 4.2 & 4.3 (skip 4.2.7-4.2.8: $Z^+$ much easier). **DUE DATE:** Feb. 12, 2015. **TOPICS:** Difference equations and transfer functions.

Please **box** your answers. Show your work. Turn in all Matlab plots and Matlab code.

1. Solve $y[n]-5y[n-1]+6y[n-2]=4u[n]$ with initial conditions $y[-1]=y[-2]=1$ by:
   
   (a) Using the one-sided $z$-transform $Z^+$ and computing the causal $Z^{-1}$.
   
   (b) Using Matlab:
   ```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 $n \leq 5$.

2. The step response (to $u[n]$) of an LTI system is known to be $2u[n]+(-2)^nu[n]$.
   
   (a) Compute the transfer function $H(z)$.
   
   (b) Compute the poles and zeros.
   
   (c) Compute the impulse response $h[n]$.
   
   (d) Compute the difference equation.

3. An LTI system has zeros $\{3,4\}$ and poles $\{1,2\}$. The transfer function=6 at $z=0$.
   
   (a) Compute the transfer function $H(z)$.
   
   (b) Compute response to $x[n]=\{1,-3,2\}$.
   
   (c) Compute the impulse response $h[n]$.
   
   (d) Compute the difference equation.

4. We wish to find the **stable** inverse system for $y[n]=x[n]-7x[n-1]+12x[n-2]$.
   
   (a) Explain why we can’t use $y[n]-7y[n-1]+12y[n-2]=x[n]$ as the inverse system.
   
   (b) Determine the stable inverse system. **HINT:** It is not causal but decays rapidly.
   
   (c) Truncate the anticausal part for $n < -10$. Delay the result by 10 to get $g[n]$.
   
   Compute $\text{conv}(G, [1,-7,12])$. 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).

   
   (a) Listen to $Y$ using `soundsc(X,24000)`. Describe what you hear.
   
   (b) $Y$ was produced from a signal $X$ using the **reverbing** system
   
   $y[n]=x[n]+(0.8)x[n-3(1024)]+(0.8)^2x[n-6(1024)]+(0.8)^3x[n-9(1024)]+\ldots$
   
   Compute the transfer function. **HINT:** $1+r+r^2+r^3+\ldots=\frac{1}{1-r}$ if $|r|<1$.
   
   **Rule:** If you have no idea what to do, start by taking the z-transform.
   
   (c) Compute the inverse filter for this system. It should be an MA system.
   
   (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.

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