Homework #11

Due Date: Apr. 18, 2005

1. The following differential equations describe a casual, linear, time-invariant system. For each
   i. Determine the poles and zeros. Is this system stable?
   ii. Determine the partial fraction expansion or $H(s)$.
   iii. Determine the impulse response, $h(t)$.

   You may use the Matlab functions, `roots` and `residue`, to solve this problem. These are all real valued signals, so don't leave $h(t)$ in terms of complex exponentials

   a. $\frac{d^3y}{dt^3}+4\frac{d^2y}{dt^2}+5\frac{dy}{dt}+2y=2\frac{d^3x}{dt^3}-8\frac{d^2x}{dt^2}+10\frac{dx}{dt}-4x$

   b. $\frac{d^2y}{dt^2}+2\frac{dy}{dt}+5y=\frac{dx}{dt}+1$

2. O&W 10.21 (a-d,h)
3. O&W 10.23. Do only the right sided sequences, e.g. the 1st, 3rd and 5th $X(z)$.
4. O&W 10.28
5. O&W 10.29. Use Matlab to determine $|H(\omega)|$ for ω in $[-\pi,\pi]$. In each case, please try to sketch the shape of the $|H(\omega)|$ prior to plotting with Matlab. You may use any Matlab tool you wish or write your own plotting program.
   a. (i) Poles: 0, zeros: $0.9e^{i\pi/4}$, $0.9e^{-i\pi/4}$
      (ii) Poles: 0, zeros: $0.5e^{i\pi/4}$, $0.5e^{-i\pi/4}$
   b. (i) Poles: 0, zeros: 0.9
      (ii) Poles: 0, zeros: 0.5
   c. Poles: $0.9e^{i\pi/3}$, $0.9e^{-i\pi/3}$, zeros: $0.9e^{i\pi/4}$, $0.9e^{-i\pi/4}$
   d. (i) Poles: 0.9,-0.9
      (ii) Poles: 0.5,-0.5
   e. (i) radius 0.9
      (ii) radius 0.5

6. For 6.a(i), 6.b(i), and 6.e(i). Determine (to within a constant scaling factor) the impulse response, $h(n)$. All three of these are real-valued, finite length sequences.

7. O&W 10.33. You may wish to use Matlab's `residue` function to solve this problem.