Homework #2

Due Date: Jan. 24, 2005

1. Down load the 3 functions, f1.m, f2.m, and f3.m from the course web site. Each of these functions can be called as follow: [y,no] = f1(x,ni); where x is a vector representing the discrete time input x(n), y is the system output y(n), and ni is the time vector (e.g. ni = [0:10]) of the input and no is the time vector of the output. For each of these systems:
   a. Choose sample inputs and test if the system is linear.
   b. Choose sample inputs and test if the system is time-invariant.
   c. Determine and plot the impulse response. Label all axes and put a title on the plot.
   d. Determine and plot the output for input signal x = [1,1,1,0,0,0,0,0,0,0,0]; n = [0:10]. Label all axes and put a title on the plot.

2. Use the Matlab function "conv" to determine the convolution of the following discrete time signals. For each, plot the results and label all axes and put a title on the plot. Be careful with the time axis.
   a. $x(n) = h(n) = \begin{cases} 1 & n = 0,1,2 \\ 0 & otherwise \end{cases}$.
   b. $x(n) = \begin{cases} 1 & n = 0,1,2 \\ 0 & otherwise \end{cases}$ and $h(n) = \begin{cases} n & n = 0,1,2 \\ 0 & otherwise \end{cases}$.
   c. $x(n) = \begin{cases} 1 & n = 0,1,2 \\ 0 & otherwise \end{cases}$ and $h(n) = \begin{cases} (0.5)^n & 0 \le n \le 5 \\ 0 & otherwise \end{cases}$.
   d. $x(n) = \begin{cases} 1 & n = 0,1,2 \\ 0 & otherwise \end{cases}$ and $h(n) = \begin{cases} (0.5)^{|n|} & -5 \le n \le 5 \\ 0 & otherwise \end{cases}$. When plotting, be extra careful of time axis.

3. We will now try to use the Matlab "conv" function to approximate a continuous convolution using the following approximation $\int x(t)h(t-\tau)d\tau \approx \sum_k x(k \cdot dt)h(l \cdot dt - k \cdot dt) \cdot dt$. For each, determine the analytical convolution result. Plot the approximation and analytical results and compare. Label all axes and put a title on the plot. Be careful with the time axis. Try at least two different values of dt.
   a. $x(t) = h(t) = \begin{cases} 1 & 0 \le t \le 3 \\ 0 & otherwise \end{cases}$.
   b. $x(t) = \begin{cases} 1 & 0 \le t \le 3 \\ 0 & otherwise \end{cases}$ and $h(t) = \begin{cases} e^{-t} & 0 \le t \le 5 \\ 0 & otherwise \end{cases}$.

4. O&W, problem 1.41
5. O&W, problem 1.43
6. O&W, problem 2.21
7. O&W, problem 2.22
8. O&W, problem 2.23
9. O&W, problem 2.26