ENEE 425

Section 0101 Fall 2004

Homework #1

This course will use Matlab intensively. For any problem in this course that you write Matlab code, you must attach a printed version of the Matlab code to your homework (the printout of a Matlab file, or ".m file" is preferable to copying and pasting a session or log file). You may put the code for several problems in a single file if you wish to save paper, as long as the beginning of each problem is made obvious.

1) Consider the discrete impulse and step functions, $\delta[n]$ and $u[n]$. **Without using Matlab**, plot the sequences below. To save space and ease comparison, draw all three plots in a single figure, using different labels, symbols, or colors to distinguish among them.
   a) Plot $u[n]$ in the range [–4,+4]
   b) Plot $u[n]$ - $u[n-2]$ in the range [–4,+4]
   c) Plot $\delta[n]+\delta[n\text{ - }1]$ in the range [–4,+4]

2) Consider the discrete signal $x[n]=\sin\left(n\pi/4\right)$. **Using Matlab**, plot the sequences below. Since these are discrete sequences and we want to show that, do not use the Matlab command `plot()`, but instead use `bar()` or `stem()`. To save space and ease comparison, put all the plots in the same figure but in separate subplots. For example:

```
figure(1)
subplot(3,1,1); bar(...
subplot(3,1,2); bar(...
subplot(3,1,3); bar(...
```

   a) Plot $x[n]$ for `n = -5:5;`.
   b) Plot $x[n]\rightarrow x[n-2]$ (i.e. $x[n]$ delayed by 2 steps) for `n = -5:5;`.
   c) Plot $\mathrm{Diff}\{x[n]\}:=x[n]-x[n-1]$ for `n = -5:5;`.

3) Consider a discrete signal $x[n]=Ce^{j\omega_0 n}$ which is periodic with $N=6$.
   a) List the allowed values of ω_0 in the range $0\le\omega_0<2\pi$
   b) List the allowed values of ω_0 in the range $-\pi<\omega_0\le+\pi$

4) Consider the discrete function $x[n]=1+\cos(\frac{\pi n}{5})$.
   a) What is N_0, its **fundamental** period?

b) Compute its Fourier Transform $X(e^{j\omega})$. [Recall that Fourier Transform ≠ Fourier Series.]

5) Consider the following family of discrete functions:

$f_1[n] = u[n] - u[n-1] = \delta[n]$

$f_2[n] = u[n] - u[n-2] = \delta[n] + \delta[n-1]$

$f_N[n] = u[n] - u[n-N] = \delta[n] + \delta[n-1] + \cdots + \delta[n-(N-1)]$

a) Compute the Fourier Transform $F_1(e^{j\omega})$ of $f_1[n]$.

b) Compute the Fourier Transform $F_5(e^{j\omega})$ of $f_5[n]$. Simplify it based on the fact that it is the sum of a finite geometric series.

c) Compute the Fourier Transform $F_N(e^{j\omega})$ of $f_N[n]$, simplified based on the fact that it is the sum of a finite geometric series.