Homework 8 CENG 5131 Due Oct 27

Problem 1
30 Points
Compute the Fourier transform of the time function

$$f(t) = 2e^{-3t}, \quad t \geq 0$$

(a) (10) By finding $F(iw)$, the analytic Fourier Transform

(b) (10) By using the MATLAB command FFT to compute the FFT sampling 128 points between $t = 0$ and $t = 3$.

(c) (10) Plot the results of the FFT using FFTSHIFT and compare on the same plot the magnitudes of the results from Part a and Part b.

Hint: For the plot consider a command such as plot(w,abs(Fa),W,abs(Fc),'o') so that the discrete values of ω (w) in the computed Fc will appear as circles. Fa is the analytical solution plotted as a continuous function. Learn the MATLAB commands **linspace, fft, fftshift, abs**

Problem 2
30 Points

(a) Write a MATLAB script that computes the DFT directly from the definition with the inputs

  (i) N, the number of sample points;

  (ii) f, the vector of sample points.

(b) Compute the analytical FFT of the sequence $f = \{1\ 1\ 0\ 0\ 0\ 0\ 0\ 0\}$.

(c) Test the routine of Part 1 on the sequence $f = \{1\ 1\ 0\ 0\ 0\ 0\ 0\ 0\}$ and compare to the results of Part 2.

Problem 3
40 Points
MATLAB FFT resolution Numerical techniques usually require some trial and error. For example, the proper number of sample points N and the sampling period of the FFT are not generally known for an arbitrary signal. Assume that a signal is given analytically and various values of sampling times and sampling period are to be tried.

One method is to choose a reasonable value for the number of samples N and compute the spectrum of the signal. Then, let $N1 = 2 * N$ and recompute. This is repeated until the spectrum of two subsequent calculations are very close. Start with 64 samples.

Assume the function

$$\sin(0.6\pi t) + 0.5\sin(0.64\pi t),$$

sampled every second for 512 points, is to be analyzed.

(a) Compute the magnitude of the FFT for 64, 128, 256, and 512 points and plot the results.

(b) Analyze each plot and compare the frequency resolution for each.

(c) For the final plot, if there appear to be several distinct frequencies, pick off the peaks and print the frequencies that correspond. (20 Points)

hint Use MATLAB command **ginput** .