ECE 454/554 Homework #3 Due Monday, October 24 at 1:00 pm. Late submissions will not be accepted. Homework submitted by Friday at 1 pm prior to the due date will be returned with any needed comments and suggestions and may be resubmitted. Please do your work independently.

DFT and window functions using MATLAB fft.

Create a sinusoid v with magnitude 1, frequency fc=1kHz, and duration Tdur = 10 seconds.

Sample it at a rate fs = 16*fc.

Find the normalized fft of the sampled signal and plot it with the frequency range from 0.995*fc to 1.005*fc. The y axis of the plot should use the values of 20*log10(abs(fft(v))).

Note that if properly normalized the magnitude of the fft at f=fc should be 1, or 0 dB.

Expand the plot and make note of the frequency offset from fc where the next data point is on the plot and how many dB that point is below the peak at f = fc. If you temporarily change Tdur from 10 seconds to 1 second does it change how that plot looks? What is the frequency and magnitude of the datapoints adjacent to fc?   Return Tdur to 10 seconds.

Copy the frequency domain plot to a document file along with its description.

Now extend the duration to Tdur + 0.5*T where T = 1/fc. This will add an additional half cycle to the total duration.

Rerun the program and note the changes:

- What is the amplitude of the peak? Is it wider than before the Tdur change?
- What is the magnitude of the points adjacent to fc?

Now we want to address the "leakage" problem by using a window function that will reduce the significance of the fractional cycle.   Try several of these functions and decide which yield the best results. There might be several that yield better results for different reasons.

This assignment has a value of 20 points. Points will be subtracted for poor code quality (including warnings and lack of comments, unclearly named variables), for failure to achieve reasonable results, and for a lack of astute observations.

Please submit your code sample using one of the windows functions and a document with your results and observations. I hope you enjoy this project.

MATLAB built-in windowing functions that can be found at:
https://www.mathworks.com/help/signal/ref/window.html

To use these functions you probably need to have the DSP Toolkit installed