Exercise 3 — EE6733 – Reading Course

Target Deadline: Friday July 27th

PLOTTING FREQUENCY SPECTURM WITH FFT

ALL SCRIPTS SHOULD APPLY THE CODING STANDARDS WE DISCUSS IN CLASS.
READABILITY, EFFICIENCY, MODULARLIZATION AND GENERALIZATION ARE IMPORTANT CONSIDERATIONS BEYOND FUNCTIONALITY

Useful functions for this assignment: `cos()`, `plot()`, `subplot()`, `xlabel()`, `ylabel()`, `title()`, `text()`, `fft()`, `real()`, `imag()` `cart2pol()`

Question 1: Write a script which plots a sinusoid (use a cosine) in the time and frequency domains (magnitude only), sampled at a rate f_s = 30Hz, with duration T = 5 sec. The sinusoid should have an amplitude A = 5 mV, and a frequency f_0 = 3 Hz.

Put both representations in the same figure (ie use subplot), title your plots and label the axes. Leave the frequency domain representation unshifted (ie show one period from 0 to f_s), and make sure you set your scale to display in Hz. Also make sure you scale the magnitude to represent mV (x 1/N). In text on the plots, indicate the amplitude and frequency of the signal. Make sure the frequency and amplitude are consistent across domains.

Question 2: Adjust the script you write in part 1 by adding a second sinusoid. The second signal should have all the same parameters, except for a decreased T = 1 sec. Plot the time and frequency representations of both sinusoids in the same figure, superimposing one over the other. Be ready to explain in class/meeting-time (and derive mathematically) what you observe in terms of the relationship between signal duration T and frequency resolution df.

Question 3: Write a script to plot the spectrums, one-at-a-time, of a series of sinusoids (use a cosine) sampled at a rate which changes from f_s = 10 Hz to f_s = 3 Hz in increments of 1 Hz. Leave all other parameters as in part 1. Use the `pause()` function to cycle through your plots one at a time and observe what happens. You should see the frequency components getting closer together and eventually overlap. Be ready to explain in class/meeting-time what you observe in terms of the Nyquist sampling rate.

Question 4: Come to class/meeting-time prepared to derive the frequency-domain representation of a cosine signal from first principles (ie the definition of the Fourier transform).