Experiment No: 4 – Time-Domain Windowing Techniques

1. The input signal is given by $x_a(t) = 0.1\sin(30\pi t) + \cos(36\pi t) + 0.5\sin(14\pi t)$. Assuming sampling frequency of 100 samples/sec $t = 0{:}\frac{1}{100}{:}10$, say, calculate the DFT in the following cases and plot it with respect to continuous frequency (Hz):
   (a) For 100 samples of the sequence (i.e., $fft(x(1{:}100))$)
   (b) For 210 samples of the sequence (i.e., $fft(x(1{:}210))$)

What do you observe in both cases? Are they giving the same results in the frequency domain?

2. Consider the case of 1 (b) from the question above and perform time-domain windowing operation (element wise multiplication, using Hamming window for 210 samples, $x\_w = x(1{:}210)\ .*\ hamming(210)$).
   (a) Plot the windowed sequences x_w.
   (b) Plot the frequency spectrum for the two windowed sequences. Do you observe any difference with the respect to 1(b)? Comment on the same.

3. Estimation of the frequency components using time-domain windowing technique: Load the file “Exp4Data.txt”. Given $Fs = 114$ samples/sec.
   (a) Perform frequency analysis and identify the components. Use varying data sizes of 100 and 1000 samples and see how the frequency spectrum evolves just by using the rectangular window.
   (b) Include time-domain windowing operation using Hamming window and see the difference. Estimate the frequency components from these results. Are they different from 3. (a)?