Task-2

N = 1000;

Fs = 10e3; % Hz sample frequency

L = 32;

NFFT= L\*N;

k= 0:NFFT/2-1; % freq index for NFFT-point FFT

f= k\*Fs/NFFT; % Hz frequency vector

rectW = window(@rectwin, N);

hammingW = window(@hamming, N);

hanningW = window(@hanning, N);

blackmanW = window(@blackman, N);

windowFuncs = [rectW, hammingW, hanningW, blackmanW];

windowTitle = ["Rectangular", "Hamming", "Hanning", "Blackman"];

figure;

freq = fftshift(linspace(-Fs/2, Fs/2, N));

for j=1:4

subplot(4, 2, 2\*j-1)

win = windowFuncs(:,j)';

plot(win);

title(windowTitle(j), 'interpreter', 'latex');

xlabel('n', 'interpreter', 'latex')

ylabel('Amplitude', 'interpreter', 'latex')

grid on;

h = fft(win,NFFT); % FFT of length NFFT (zero padded)

h = h(1:NFFT/2); % retain points from 0 to fs/2

HdB= 20\*log10(abs(h));

subplot(4, 2, 2\*j);

plot(f, HdB);

title(windowTitle(j), 'interpreter', 'latex');

xlabel('Frequency(Hz)', 'interpreter', 'latex')

ylabel('Amplitude(dB)', 'interpreter', 'latex')

grid on;

end

rect\_wins = [];

Ns = [64, 128, 256, 512];

figure;

for j = 1:4

win = window(@rectwin, Ns(j));

NFFT = Ns(j)\*32;

freq = Fs/NFFT\*(0:NFFT/2 - 1);

win\_fft = fft(win, NFFT);

win\_fft = win\_fft(1:NFFT/2);

win\_dB = 20\*log10(abs(win\_fft));

subplot(2, 2, j)

plot(freq, win\_dB);

title(sprintf("$N = %d$", Ns(j)), 'interpreter', 'latex');

xlabel('Frequency(Hz)', 'interpreter', 'latex')

ylabel('Amplitude(dB)', 'interpreter', 'latex')

grid on;

end

disp("We can observe that as we increase N, number of sidelobes increases, which leads to larger oscilaations in output signal spectrum.");