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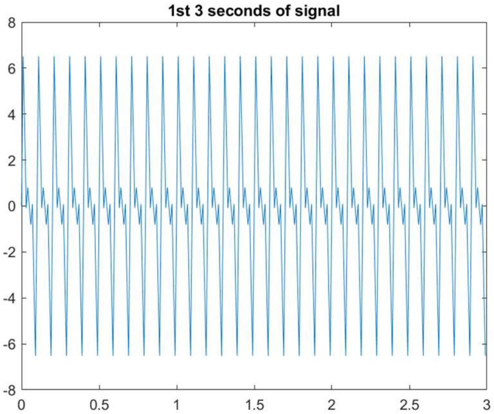
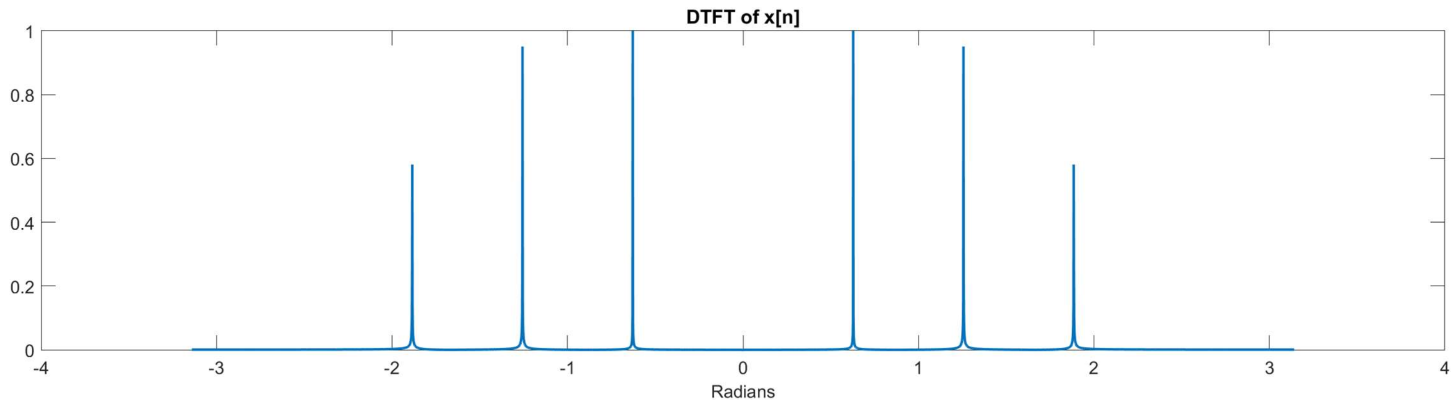
EE113 HW5 #5



-> plot(t(1:300),x(1:300))

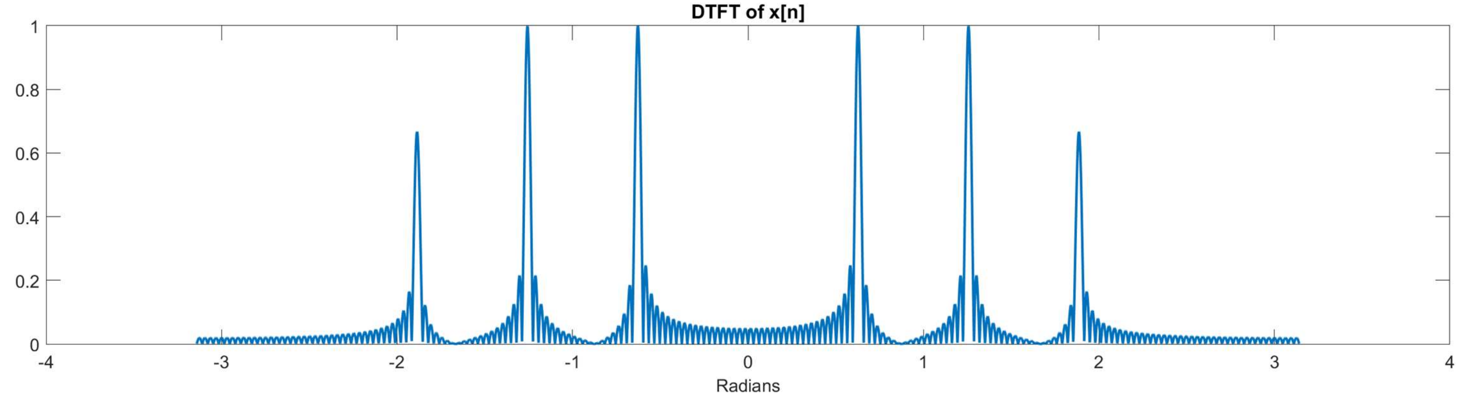
a.




```
fs = 100;       %sampling freq
t = 0:1/fs:50; %time axis
x = 2*sin(2*pi*30*t) + 3*sin(2*pi*20*(t-2)) + 3*sin(2*pi*10*(t-4)); %signal
N = length(x);

omega = 2*pi*(0:N-1)/N;
omega = fftshift(omega);
omega = unwrap(omega-2*pi); %creating the frequency axis
X = fft(x,N) ; % compute N point DFT of x
X = X/max(X) ; % rescale the DFT
plot(omega,abs(fftshift(X)),'LineWidth',2); % center DFT at 0 and plot the magnitude
title ('DTFT of x[n]' , 'fontsize' ,14)
set (gca ,'fontsize' ,14)
xlabel( 'Radians' , 'fontsize' ,14)
```

b.

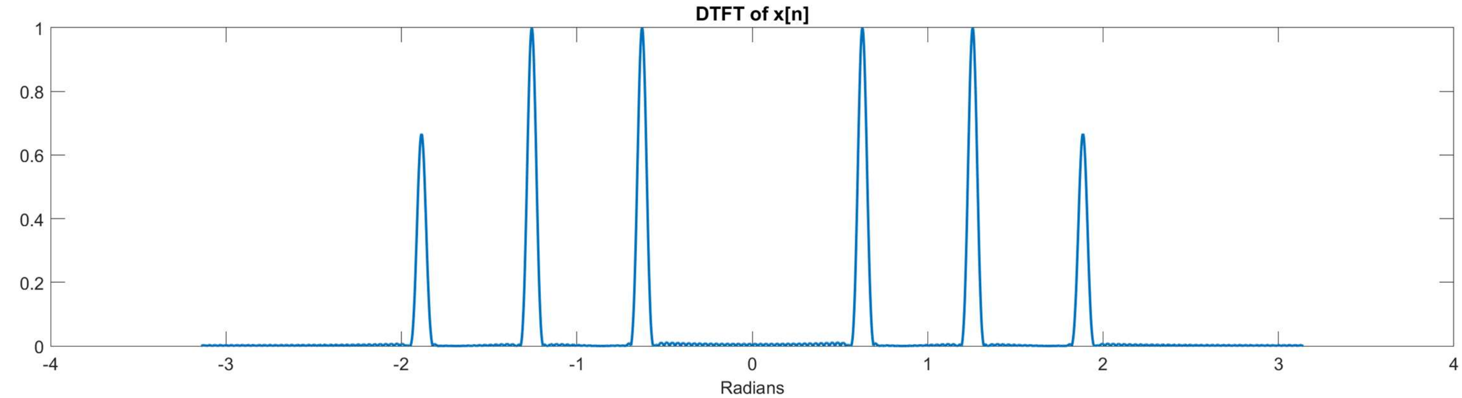



```
fs = 100;       %sampling freq
t = 0:1/fs:50; %time axis
x = 2*sin(2*pi*30*t) + 3*sin(2*pi*20*(t-2)) + 3*sin(2*pi*10*(t-
N = length(x);

W = [ones(1,200), zeros(1, N-200)];
xW = x.*W;

omega = 2*pi*(0:N-1)/N;
omega = fftshift(omega);
omega = unwrap(omega-2*pi); %creating the frequency axis
X = fft(xW,N) ; % compute N point DFT of x
X = X/max(X) ; % rescale the DFT
plot(omega,abs(fftshift(X)),'LineWidth',2); % center DFT at 0 a
title ('DTFT of x[n]' , 'fontsize' ,14)
set (gca ,'fontsize' ,14)
xlabel( 'Radians' , 'fontsize' ,14)
```

c.




```matlab
fs = 100;       %sampling freq
t = 0:1/fs:50; %time axis
x = 2*sin(2*pi*30*t) + 3*sin(2*pi*20*(t-2)) + 3*sin(2*pi*10*(t-4)); %s
N = length(x);

W = [hamming(200)', zeros(1, N-200)];
xW = x.*W;

omega = 2*pi*(0:N-1)/N;
omega = fftshift(omega);
omega = unwrap(omega-2*pi); %creating the frequency axis
X = fft(xW,N) ; % compute N point DFT of x
X = X/max(X) ; % rescale the DFT
plot(omega,abs(fftshift(X)),'LineWidth',2); % center DFT at 0 and plot
title ('DTFT of x[n]' , 'fontsize' ,14)
set (gca ,'fontsize' ,14)
xlabel( 'Radians' , 'fontsize' ,14)
```

d. The three plots from a, b, and c are reproduced below to help visualize the differences. Windowing a signal introduces ‘smearing’ where the energies of certain spectrums spread to the frequencies around them. This is easily seen in the second plot below (rectangular window). In that plot, there are still 3 main spikes but there is also a lot of noise in between the spikes (lobes). These ‘side lobes’ are the effect of windowing. Using a rectangular window causes larger discontinuities than a Hamming window (plot 3). When using a Hamming window, the main lobes are wider than those for a rectangular window, but there is much less noise in between the lobes (side lobes much smaller).