DIGITAL SIGNAL PROCESSING LAB

Fall 2024, 5th Semester

Lab Report 1

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Section: **A**

"On my honor, as a student at the University of Engineering and Technology Peshawar, I have neither given nor received unauthorized assistance on this academic work."

Signature: Hassan

Submitted To: Dr. Yasir Saleem Afridi

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Lab Report

Signal Analysis in both time and frequency domain using MATLAB

❖ Provide a .m file with detailed comments

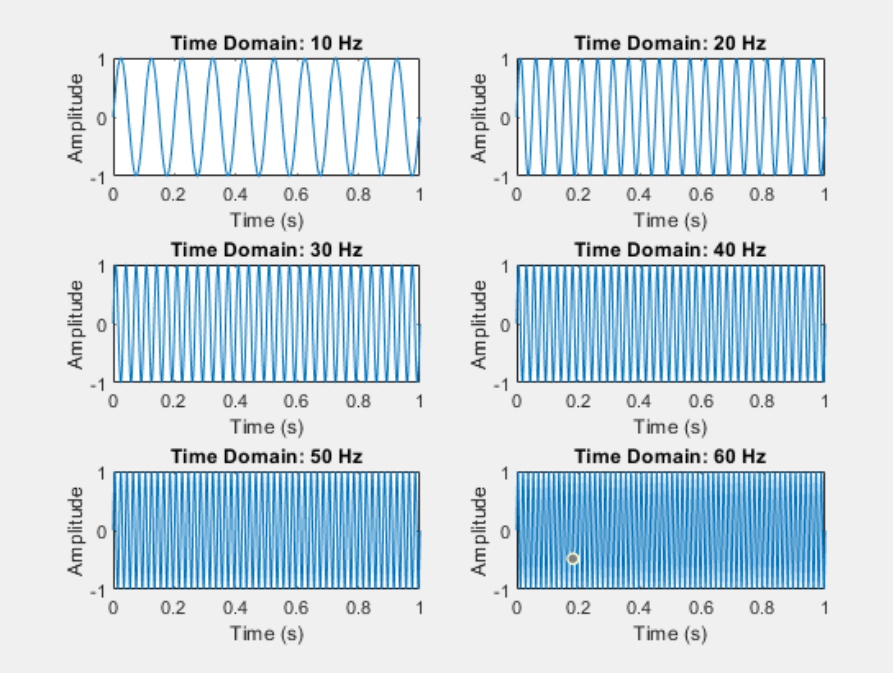
1. Will generate the signal of different frequencies say, 10,20,30,40,50,60 Hz (one second duration) using MATLAB as shown in figure 1 and transform the same signal in frequency domain using Fourier transform and will compare the frequencies with the time domain signal as shown in figure 2.

Code:

```
frequencies = [10, 20, 30, 40, 50, 60];
t = 0:0.001:1;

figure;
for i = 1:length(frequencies)
    y = sin(2*pi*frequencies(i)*t);
    subplot(3, 2, i);
    plot(t, y);
    title(['Time Domain: ' num2str(frequencies(i)) ' Hz']);
    xlabel('Time (s)');
    ylabel('Amplitude');
end
```

Output:



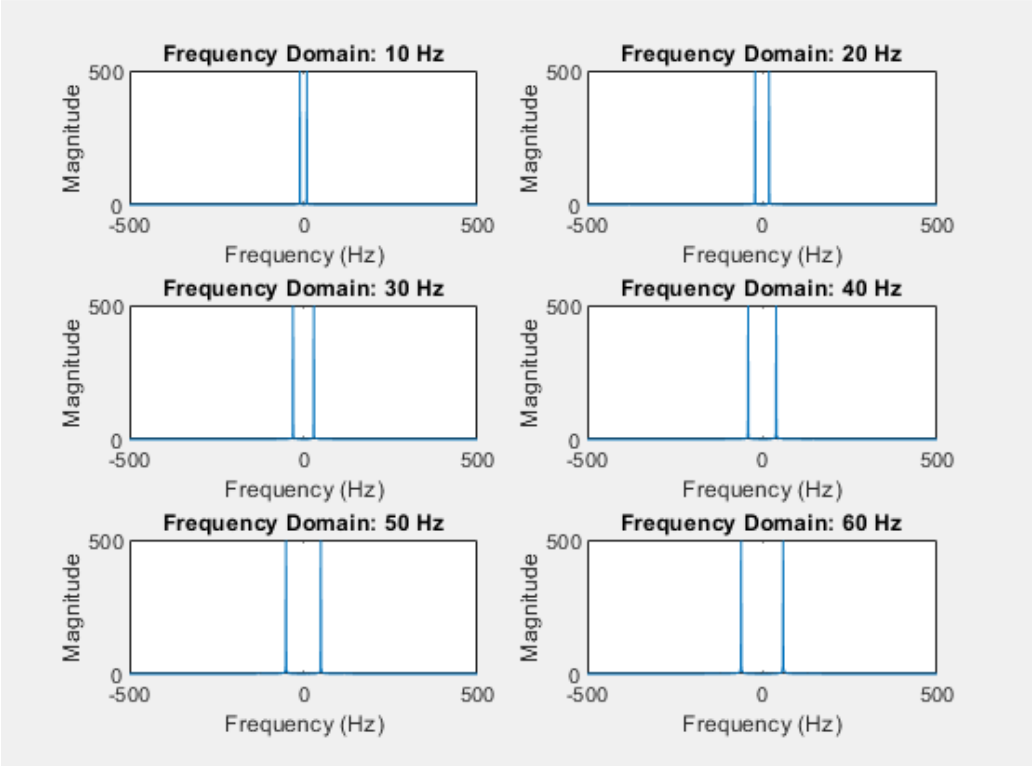
Comments:

2. Compare the Figures 1 and 2 (Generated by your code):

Code:

```
figure;
for i = 1:length(frequencies)
    y = sin(2*pi*frequencies(i)*t);
    Y = fft(y);
    Y_shifted = fftshift(abs(Y));
    freq = linspace(-500, 500, length(Y_shifted));
    subplot(3, 2, i);
    plot(freq, Y_shifted);
    title(['Frequency Domain: ' num2str(frequencies(i)) ' Hz']);
    xlabel('Frequency (Hz)');
    ylabel('Magnitude');
end
```

Output:



Remarks:

3. Add all the signals generated in step 1 and get a composite signal. (which may be considered as a voice signal)

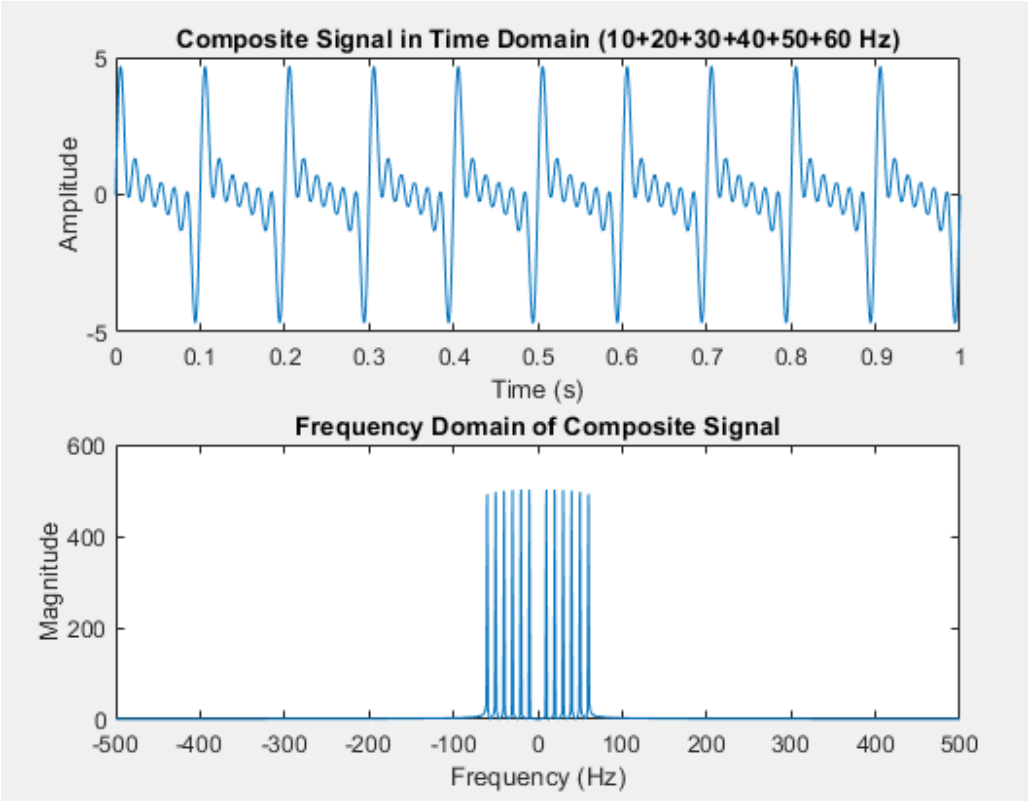
Code:

```
composite_signal = sum(sin(2*pi*frequencies' * t), 1);

figure;
subplot(2,1,1);
plot(t, composite_signal);
title('Composite Signal in Time Domain (10+20+30+40+50+60 Hz)');
xlabel('Time (s)');
ylabel('Amplitude');

composite_fft = fft(composite_signal);
composite_fft_shifted = fftshift(abs(composite_fft));
subplot(2,1,2);
plot(freq, composite_fft_shifted);
title('Frequency Domain of Composite Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

Output:



Remarks:

Generate some unwanted signal having frequencies say 80Hz and 100Hz (assume these signals represent noise) and different amplitudes say 0.5 and 0.7:

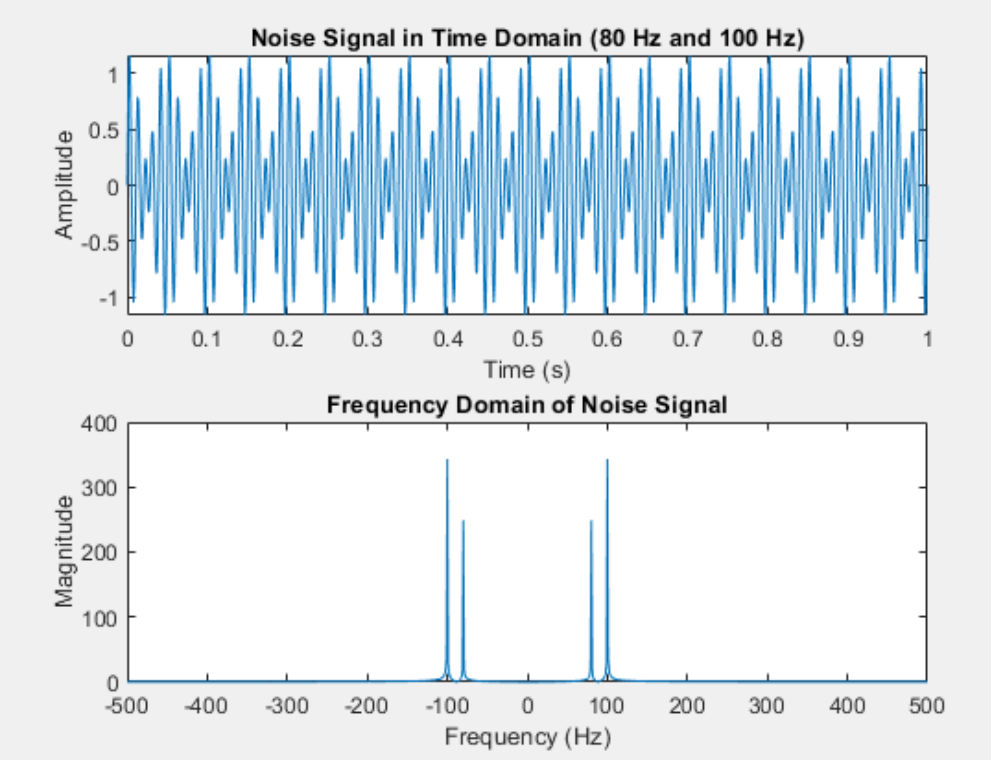
Code:

```
noise_frequencies = [80, 100];
noise_amplitudes = [0.5, 0.7];
noise_signal = sum(noise_amplitudes' .* sin(2*pi*noise_frequencies' * t), 1);

figure;
subplot(2,1,1);
plot(t, noise_signal);
title('Noise Signal in Time Domain (80 Hz and 100 Hz)');
xlabel('Time (s)');
ylabel('Amplitude');

noise_fft = fft(noise_signal);
noise_fft_shifted = fftshift(abs(noise_fft));
subplot(2,1,2);
plot(freq, noise_fft_shifted);
title('Frequency Domain of Noise Signal');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

Output:



Remarks:

Add the noise to the composite signal (assume the noise is added to the signal during transmission) and obtain frequency spectrum:

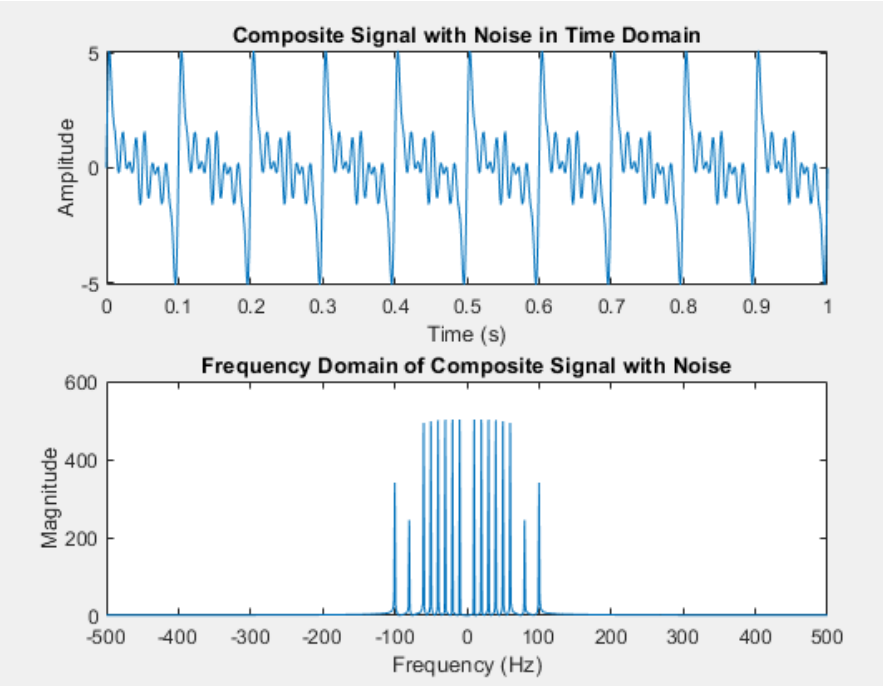
Code:

```
signal_with_noise = composite_signal + noise_signal;

figure;
subplot(2,1,1);
plot(t, signal_with_noise);
title('Composite Signal with Noise in Time Domain');
xlabel('Time (s)');
ylabel('Amplitude');

signal_with_noise_fft = fft(signal_with_noise);
signal_with_noise_fft_shifted = fftshift(abs(signal_with_noise_fft));
subplot(2,1,2);
plot(freq, signal_with_noise_fft_shifted);
title('Frequency Domain of Composite Signal with Noise');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

Output:



Remarks:

Conclusion:

Demonstration of Concepts	**Poor (Does not meet expectation (1))** The student failed to demonstrate a clear understanding of the assignment concepts	**Fair (Meet Expectation (2-3))** The student demonstrated a clear understanding of some of the assignment concepts	**Good (Exceeds Expectation (4-5)** The student demonstrated a clear understanding of the assignment concepts	**Score** **30%**
Accuracy	The student completed (<50%) tasks and provided MATLAB code and/or Simulink models with errors. Outputs shown are not correct in form of graphs (no labels) and/or tables along with incorrect analysis or remarks.	The student completed partial tasks (50% - <90%) with accurate MATLAB code and/or Simulink models. Correct outputs are shown in form of graphs (without labels) and/or tables along with correct analysis or remarks.	The student completed all required tasks (90%-100%) with accurate MATLAB code and/or Simulink models. Correct outputs are shown in form of labeled graphs and/or tables along with correct analysis or remarks.	**30%**
Following Directions	The student clearly failed to follow the verbal and written instructions to successfully complete the lab	The student failed to follow the some of the verbal and written instructions to successfully complete all requirements of the lab	The student followed the verbal and written instructions to successfully complete requirements of the lab	**20%**
Time Utilization	The student failed to complete even part of the lab in the allotted amount of time	The student failed to complete the entire lab in the allotted amount of time	The student completed the lab in its entirety in the allotted amount of time	**20%**