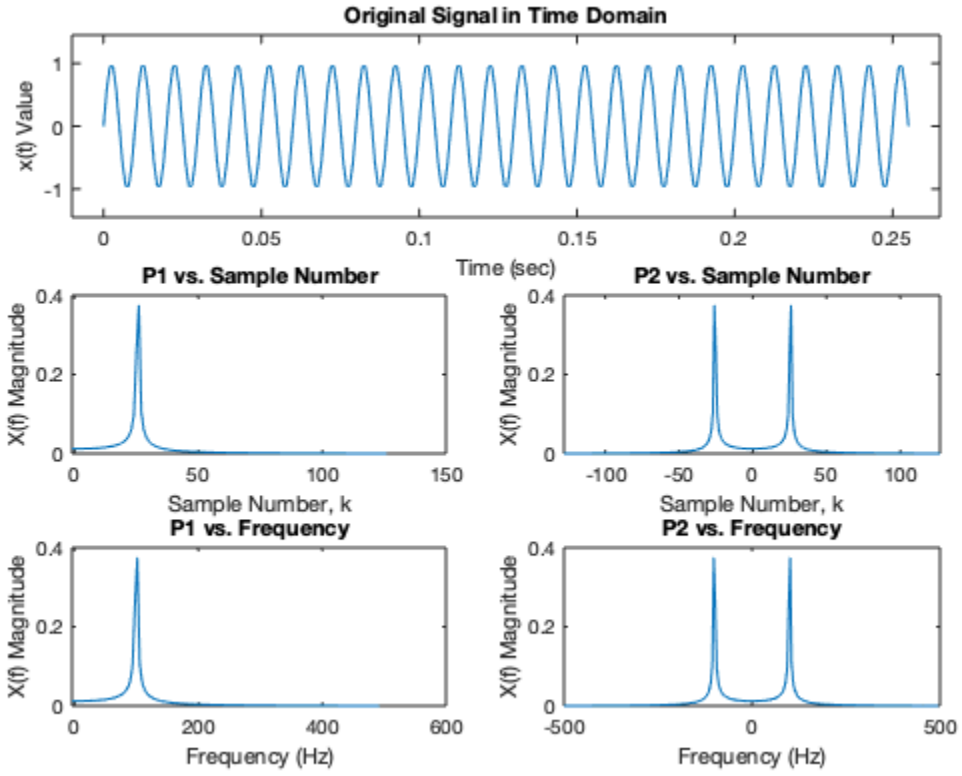
Table of Contents

PROBLEM 1

```
clear
close all

Fs = 1000;
Ts = 1/Fs;
N = 256;
Nfft = N;

evN = N-mod(N,2);

% part a
t = (0:N-1)*Ts;

% part b
x = sin(2*pi*100*t);

subplot(3,2,[1,2]);
plot(t,x);
xlabel("Time (sec)");
ylabel("x(t) Value");
title("Original Signal in Time Domain");
xlim([min(t)-0.01,max(t)+0.01]);
ylim([min(x)-0.5,max(x)+0.5]);

% part c and d
Xf = fft(x, Nfft);
XfMag = abs(Xf);
XfMagnorm = XfMag/N;
Xfshift = fftshift(XfMagnorm);

P2 = Xfshift;
k2 = (-evN/2:N-1-evN/2);
k2len = size(k2,2);

P1 = P2(k2len/2:k2len-1);
k1 = k2(k2len/2:k2len-1);

f2 = (0:N-1)*(Fs/N) - (Fs-(mod(N,2)*(Fs/N)))/2;
f1 = f2(k2len/2:k2len-1);


subplot(3,2,3);
```

```
plot(k1, P1);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P1 vs. Sample Number");

subplot(3,2,4);
plot(k2, P2);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P2 vs. Sample Number");

subplot(3,2,5);
plot(f1, P1);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P1 vs. Frequency");

subplot(3,2,6);
plot(f2, P2);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P2 vs. Frequency");
```

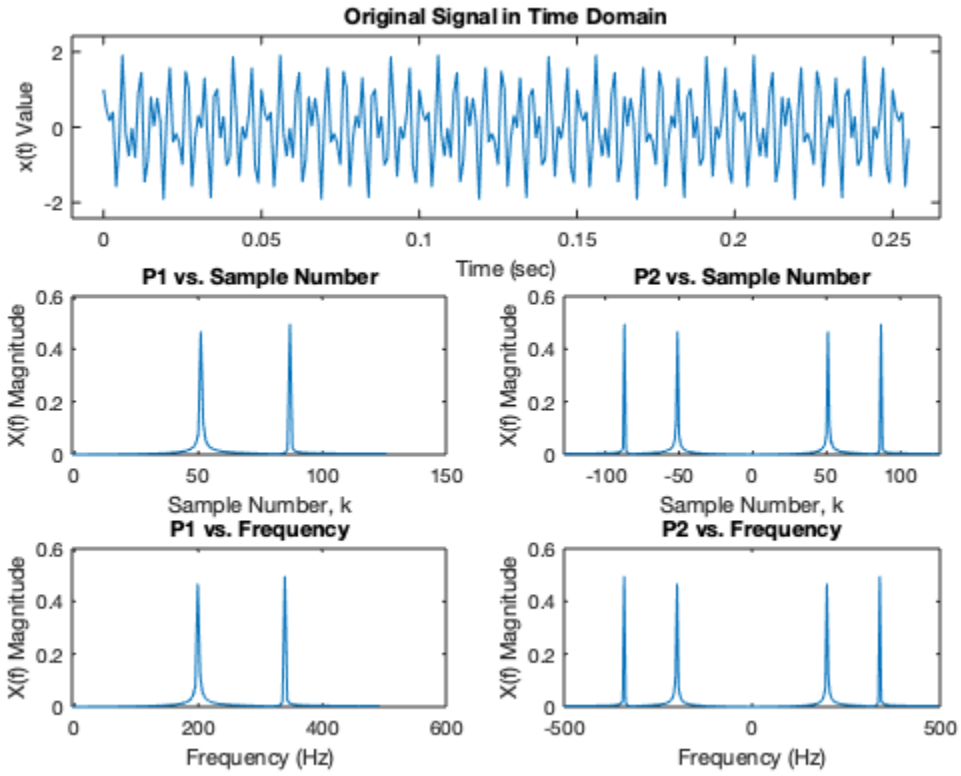


PROBLEM 2

```
close all
```

```
y = sin(2*pi*200*t) + cos(2*pi*340*t);


Fs = 1000;
Ts = 1/Fs;
N = 256;
Nfft = N;

evN = N-mod(N,2);

% part a
t = (0:N-1)*Ts;

% part b
x = sin(2*pi*200*t) + cos(2*pi*340*t);

subplot(3,2,[1,2]);
plot(t,x);
xlabel("Time (sec)");
ylabel("x(t) Value");
title("Original Signal in Time Domain");
xlim([min(t)-0.01,max(t)+0.01]);
ylim([min(x)-0.5,max(x)+0.5]);

% part c
Xf = fft(x, Nfft);
XfMag = abs(Xf);
XfMagnorm = XfMag/N;
Xfshift = fftshift(XfMagnorm);

P2 = Xfshift;
k2 = (-evN/2:N-1-evN/2);
k2len = size(k2,2);

P1 = P2(k2len/2:k2len-1);
k1 = k2(k2len/2:k2len-1);

f2 = (0:N-1)*(Fs/N) - (Fs-(mod(N,2)*(Fs/N)))/2;
f1 = f2(k2len/2:k2len-1);


subplot(3,2,3);
plot(k1, P1);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P1 vs. Sample Number");

subplot(3,2,4);
plot(k2, P2);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P2 vs. Sample Number");
```

```
subplot(3,2,5);
plot(f1, P1);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P1 vs. Frequency");

subplot(3,2,6);
plot(f2, P2);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P2 vs. Frequency");
```



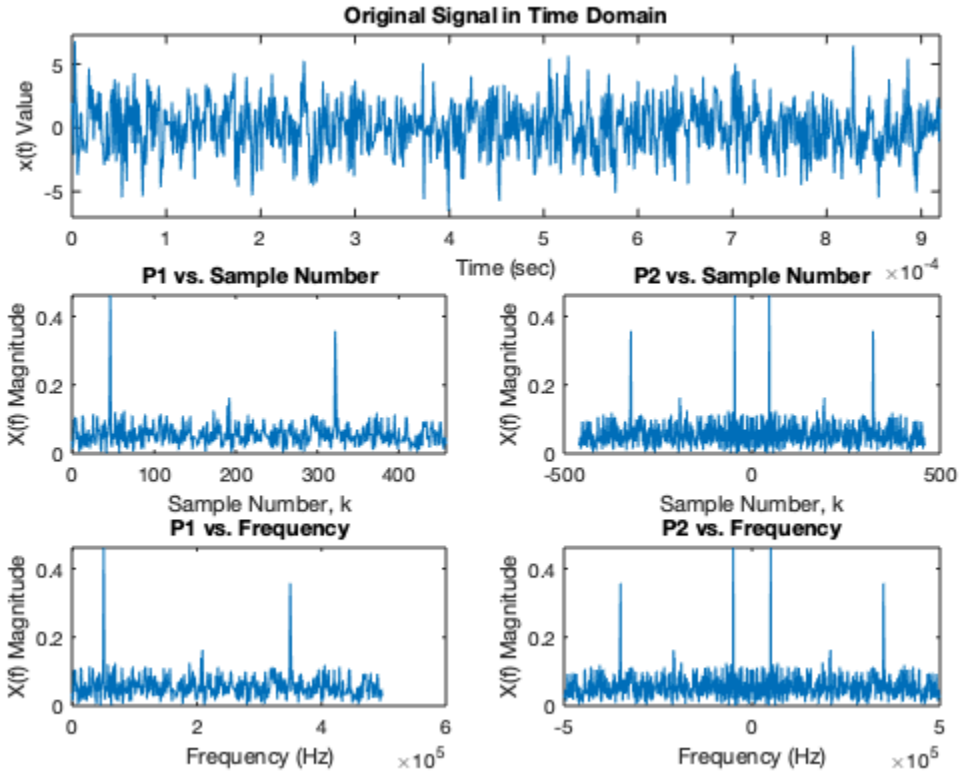
PROBLEM 3

```
close all

load x;

N = size(x,2);
Fs = 1000000;
Ts = 1/Fs;
Nfft = N;

evN = N-mod(N,2);

% part a
```

```
t = (0:N-1)*Ts;

% part b

subplot(3,2,[1,2]);
plot(t,x);
xlabel("Time (sec)");
ylabel("x(t) Value");
title("Original Signal in Time Domain");
xlim([min(t),max(t)]);
ylim([min(x)-0.5,max(x)+0.5]);

% part c
Xf = fft(x, Nfft);
XfMag = abs(Xf);
XfMagnorm = XfMag/N;
Xfshift = fftshift(XfMagnorm);

P2 = Xfshift;
k2 = (-evN/2:N-1-evN/2);
k2len = size(k2,2);
k2len = k2len - mod(k2len,2);

P1 = P2(k2len/2:k2len-1);
k1 = k2(k2len/2:k2len-1);

f2 = (0:N-1)*(Fs/N) - (Fs-(mod(N,2)*(Fs/N)))/2;
f1 = f2(k2len/2:k2len-1);


subplot(3,2,3);
plot(k1, P1);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P1 vs. Sample Number");

subplot(3,2,4);
plot(k2, P2);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P2 vs. Sample Number");

subplot(3,2,5);
plot(f1, P1);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P1 vs. Frequency");

subplot(3,2,6);
plot(f2, P2);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P2 vs. Frequency");
```

```
fprintf("3a) No it is almost impossible to tell the center frequencies
 due to the noise. " + newline);
fprintf("3b) It is easier to observe the center frequencies. There are
 two spikes in frequenices that stand out." + newline);
fprintf("3c) Frequencies observed: s1(t) @ 49950 Hz and s2(t) @ 349600
 Hz.");
%49950 Hz and 349600 Hz
```

```
3a) No it is almost impossible to tell the center frequencies due to
 the noise.
3b) It is easier to observe the center frequencies. There are two
 spikes in frequenices that stand out.
3c) Frequencies observed: s1(t) @ 49950 Hz and s2(t) @ 349600 Hz.
```



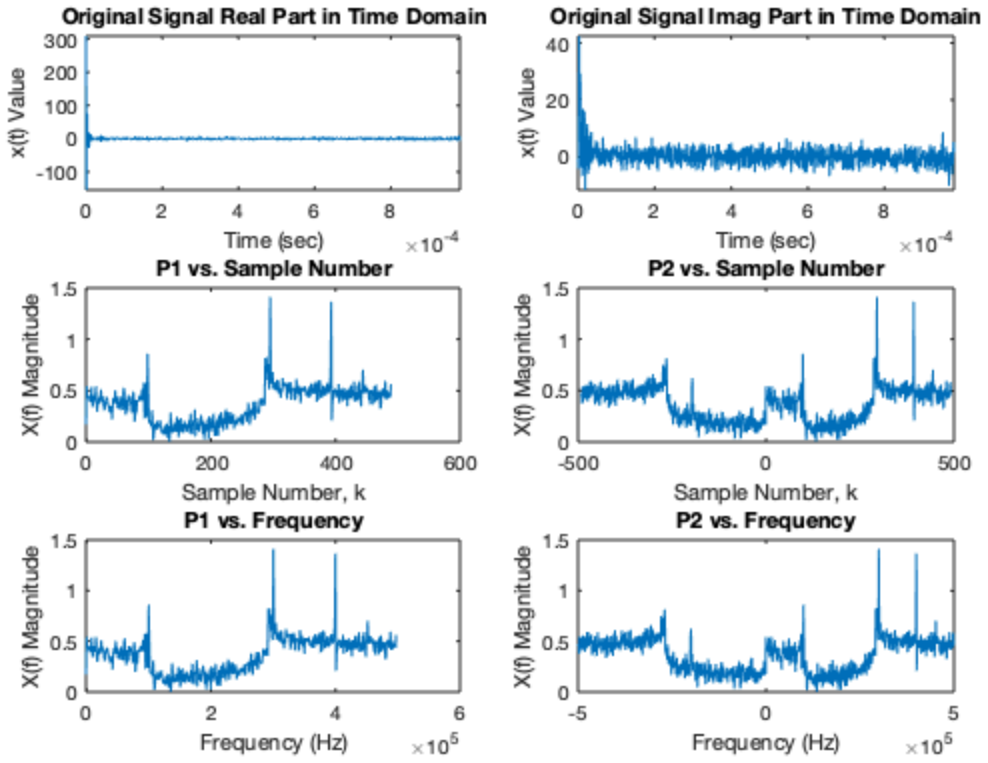
PROBLEM 4

```
close all

load y;
x = y;

N = size(x,2);
Fs = 1000000;
Ts = 1/Fs;
Nfft = N;
```

```
evN = N-mod(N,2);

% part a
t = (0:N-1)*Ts;

% part b
rx = real(x);
ix = imag(x);

subplot(3,2,1);
plot(t,rx);
xlabel("Time (sec)");
ylabel("x(t) Value");
title("Original Signal Real Part in Time Domain");
xlim([min(t),max(t)]);
ylim([min(rx),max(rx)]);

subplot(3,2,2);
plot(t,ix);
xlabel("Time (sec)");
ylabel("x(t) Value");
title("Original Signal Imag Part in Time Domain");
xlim([min(t),max(t)]);
ylim([min(ix),max(ix)]);

% part c
Xf = fft(x, Nfft);
XfMag = abs(Xf);
XfMagnorm = XfMag/N;
Xfshift = fftshift(XfMagnorm);

P2 = Xfshift;
k2 = (-evN/2:N-1-evN/2);
k2len = size(k2,2);
k2len = k2len - mod(k2len,2);

P1 = P2(k2len/2:k2len-1);
k1 = k2(k2len/2:k2len-1);

f2 = (0:N-1)*(Fs/N) - (Fs-(mod(N,2)*(Fs/N)))/2;
f1 = f2(k2len/2:k2len-1);


subplot(3,2,3);
plot(k1, P1);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P1 vs. Sample Number");

subplot(3,2,4);
plot(k2, P2);
xlabel("Sample Number, k");
ylabel("X(f) Magnitude");
title("P2 vs. Sample Number");
```

```
subplot(3,2,5);
plot(f1, P1);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P1 vs. Frequency");

subplot(3,2,6);
plot(f2, P2);
xlabel("Frequency (Hz)");
ylabel("X(f) Magnitude");
title("P2 vs. Frequency");


fprintf("4) 5 major frequencies were observed." + newline);
fprintf("List of signals observed in order of strength:" + newline);
fprintf("s1(t) @ 300100 Hz" + newline);
fprintf("s2(t) @ 399800 Hz" + newline);
fprintf("s3(t) @ 99690 Hz" + newline);
fprintf("s4(t) @ -269600 Hz" + newline);
fprintf("s5(t) @ -199400 Hz" + newline);


% 300100 Hz
% 399800 Hz
% 99690 Hz
% -269600 Hz
% -199400
```

```
4) 5 major frequencies were observed.
List of signals observed in order of strength:
s1(t) @ 300100 Hz
s2(t) @ 399800 Hz
s3(t) @ 99690 Hz
s4(t) @ -269600 Hz
s5(t) @ -199400 Hz
```



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