Mid-term Lab Assessment Task

Submitted By:		
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Parameters:

Consider, your ID = **AB-CDEFG-H ;**

=20-42406-1;

[please use any random value if assigned value comes out zero]

AMP1 = **A+B**	AMP2 = **E+F**
FREQ1= **BC**	FREQ2= **DE**

Put Value in the following Table:

AMP1 = 2+0=2	AMP2 = 4+0=4
FREQ1= 04	FREQ2= 24

Problem Statement:

Suppose, you want to send information from two sources. Second signal is 30 degree shifted from the first signal and Amplitude of the signals are AMP1 and AMP2 respectively. Frequency of the signals are FREQ1 and FREQ2 respectively. Show the signals in time domain in a figure titled **"Input signal"**.

Task 1. Make a composite signal from two source and convert it to frequency domain. Show the positive frequency in figure title "**Composite Signal**"

Task 2. Quantize the composite signal in 16 equally distributed levels and show at 2 cycle in a new figure titled **"Quantized Signal".**

Task 3. During the transmission, Signal suffered unwanted noise with amplitude of 0.2 V. Determine the Bandwidth, SNR and max. capacity of the composite signal considering SNR.

Task 4. consider the first source produced harmonic with $(\frac{1}{4})^{th}$ of the main signal amplitude and second signal produce harmonic with $(\frac{1}{2})^{th}$ of the main signal amplitude. Determine the Bandwidth, THD, Max. capacity of the signals considering THD.

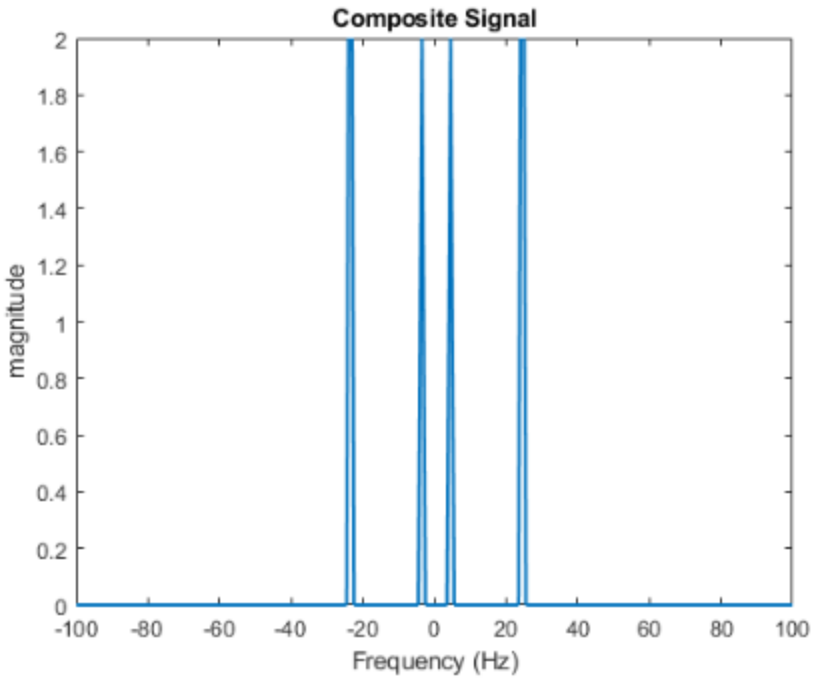
Problem Solution:

Task 1:

Code:

```
%Task1
%AB-CDEFG-H
%20-42406-1
%AMP1=A+B=2;AMP2 = E+F=4
%FREQ1= BC=04;FREQ2=DE=24
fs=1000;
a1=2;
a2=4;
f1=04;
f2=24;
t=0:1/fs:1-1/fs;
x1=a1*sin(2*3.1416*f1*t);
x2=a2*sin(2*3.1416*f2*t+30*(3.1416/180));
x=a1*sin(2*3.1416*f1*t)+a2*sin(2*3.1416*f2*t+30);
fx=fft(x);
fx=fftshift(fx)/(fs/2);
f = fs/2*linspace(-1,1,fs);
figure;
plot(f, abs(fx),'LineWidth',1.5);
title('Composite Signal');
axis([-100 100 0 2])
xlabel('Frequency (Hz)');
ylabel('magnitude');
```

Result:

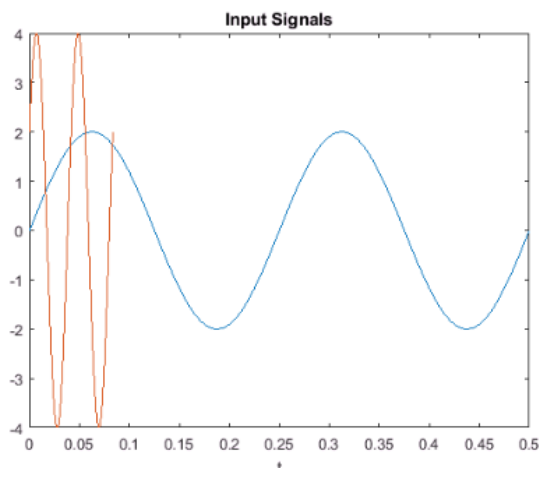


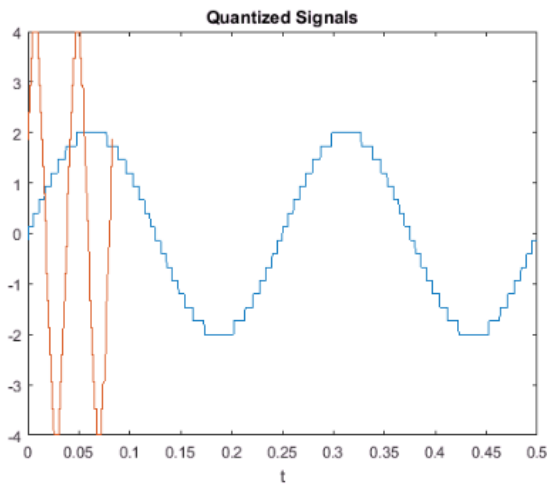
Task 2:

Code:

```
%Task2
a1 = 2;
a2 = 4;
f1 = 04;
f2 = 24;
P1 = 0;
P2 = 30*pi/180;
T1 = 1/f1;
T2 = 1/f2;
t1 = linspace(0,2*T1,1000);
t2 = linspace(0,2*T2,1000);
x1 = a1*sin(2*pi*f1*t1+P1);
x2 = a2*sin(2*pi*f2*t2+P2);
plot(t1,x1);
hold on
plot(t2,x2);
xlabel('t');
title('Input Signals');
quatization_levels1 = linspace(-a1,a1,16);
quatization_levels2 = linspace(-a2,a2,16);
quatised_x1 = zeros(1,length(x1));
quatised_x2 = zeros(1,length(x2));
for i = 1:length(x1)
[~,index] = min(abs(quatization_levels1-x1(i)));
quatised_x1(i) = quatization_levels1(index);
end
for i = 1:length(x2)
[~,index] = min(abs(quatization_levels2-x2(i)));
quatised_x2(i) = quatization_levels2(index);
end
figure;
plot(t1,quatised_x1);
hold on
plot(t2,quatised_x2);
xlabel('t');
title('Quantized Signals');
```

Result:



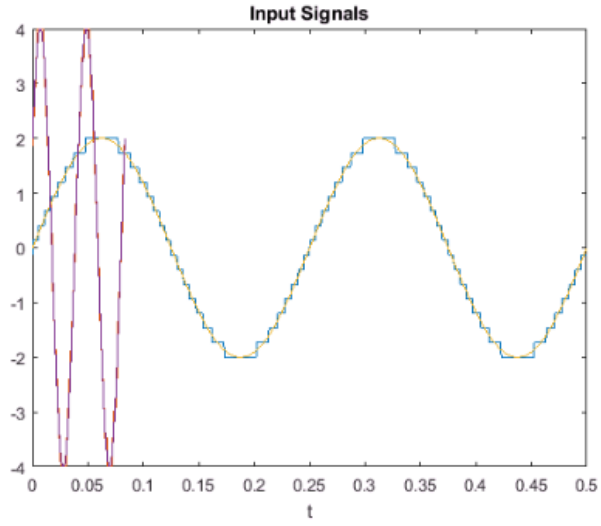


Task 3:

Code:

```
%Task3
a1 = 2; %amp1
a2 = 4; %amp2
f1 = 04; %freq1
f2 = 24; %freq2
P1 = 0;
P2 = 30*pi/180;
T1 = 1/f1;
T2 = 1/f2;
t1 = linspace(0,2*T1,1000);
t2 = linspace(0,2*T2,1000);
x1 = a1*sin(2*pi*f1*t1+P1);
x2 = a2*sin(2*pi*f2*t2+P2);
plot(t1,x1);
hold on
plot(t2,x2);
xlabel('t');
title('Input Signals');
noise_amp = 0.2;
x1_noisy = x1 + noise_amp*randn(1,length(x1));
x2_noisy = x2 + noise_amp*randn(1,length(x2));
signal_power = (sum(x1.^2)+sum(x2.^2))/1000;
noise_power = noise_amp*95;
SNR = signal_power/noise_power;
SNRdB = 10*log10(SNR);
fprintf('SNR = %f, and in dB = %f\n',SNR,SNRdB);
SNR = 4.259961, dB = 6.294056
capacity = 95*log2(1+SNR)
```

Result:




```
SNR = 0.526000, and in dB = -2.790143
SNR = 4.2600
dB = 6.2941
capacity = 227.5299
```

Task 4:

Code:

```
%Task4
fs=8000;
f=400;
t=0:1/fs:1-1/fs;
AMP1=2;
powfund=AMP1^2/2;
AMP2=4;
powharm = AMP2^2/2;
S1=0.25;
S2=0.5;
FREQ1=04; FREQ2=24;
x1 = AMP1*cos(2*pi*FREQ1*t) + AMP2*sin(2*pi*FREQ2*t) + S1*randn(size(t));
THD1 = thd(x1)
x2 = AMP1*cos(2*pi*FREQ1*t) + AMP2*sin(2*pi*FREQ2*t) +S2*randn(size(t));
THD2 = thd(x2)
BW1=obw(x1,fs)
Capacity1=BW1*log2(1+THD1)
x2 = AMP1*cos(2*pi*FREQ1*t) + AMP2*sin(2*pi*FREQ2*t) +S2*randn(size(t));
THD2 = thd(x2)
BW2=obw(x2,fs)
Capacity2=BW2*log2(1+THD2)
```

Result:

```
THD1 = -41.2954

THD2 = -37.9405
BW1 = 689.5975
Capacity1 = 3.6773e+03 + 3.1255e+03i

THD2 = -40.5155
BW2 = 3.1691e+03
Capacity2 = 1.6810e+04 + 1.4364e+04i
```