Signals & Systems Laboratory

CSE- 301L

Lab # 06

OBJECTIVES OF THE LAB

In this lab, we will cover the following topics:

- *Generating Sinusoids*
- *Addition of Sinusoids with Variation in Parameters and their Plots*
- *Linear Phase Shift Concept When Dealing With Sum of Sinusoids*

6.1 GENERATING SINUSOIDS

Sinusoidal sequences are implemented using sin() & cos() functions.
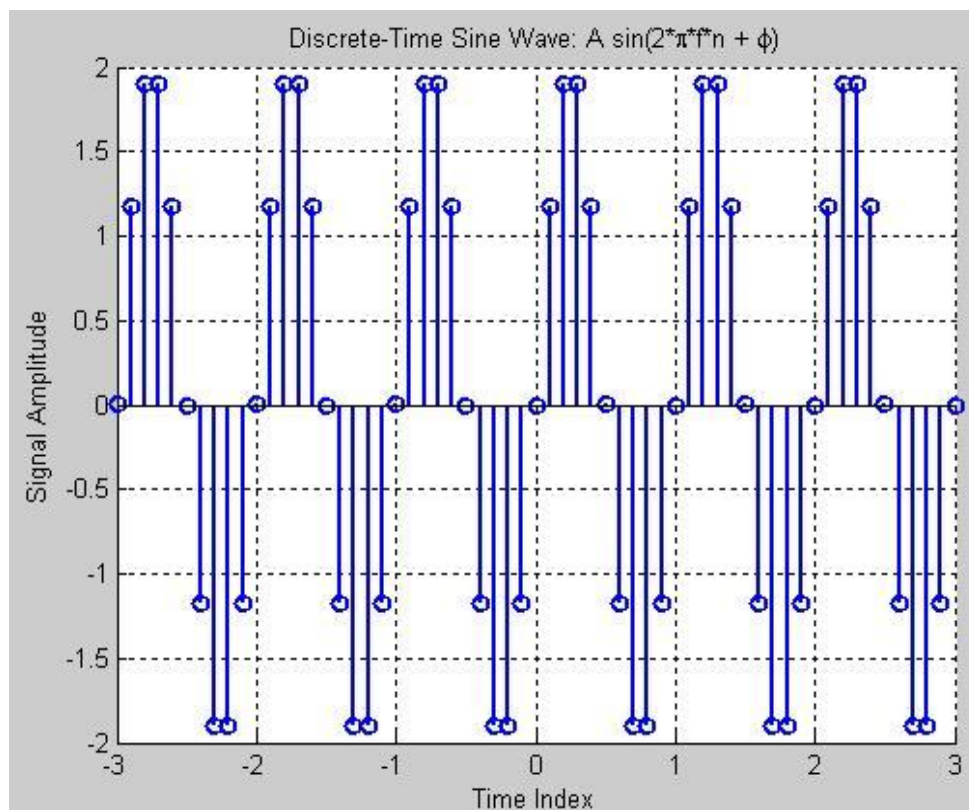
Example: Continuous-Time Sinusoid

```
clc;
clear all;
close all;
f0 = 3;
A = 5;
t = -1:0.005:1;
y = A*cos(2*pi*f0*t);
figure, plot(t, y,'*:');
xlabel('Time, sec'), ylabel('Amplitude');
title('Graph of sinusoid');
```
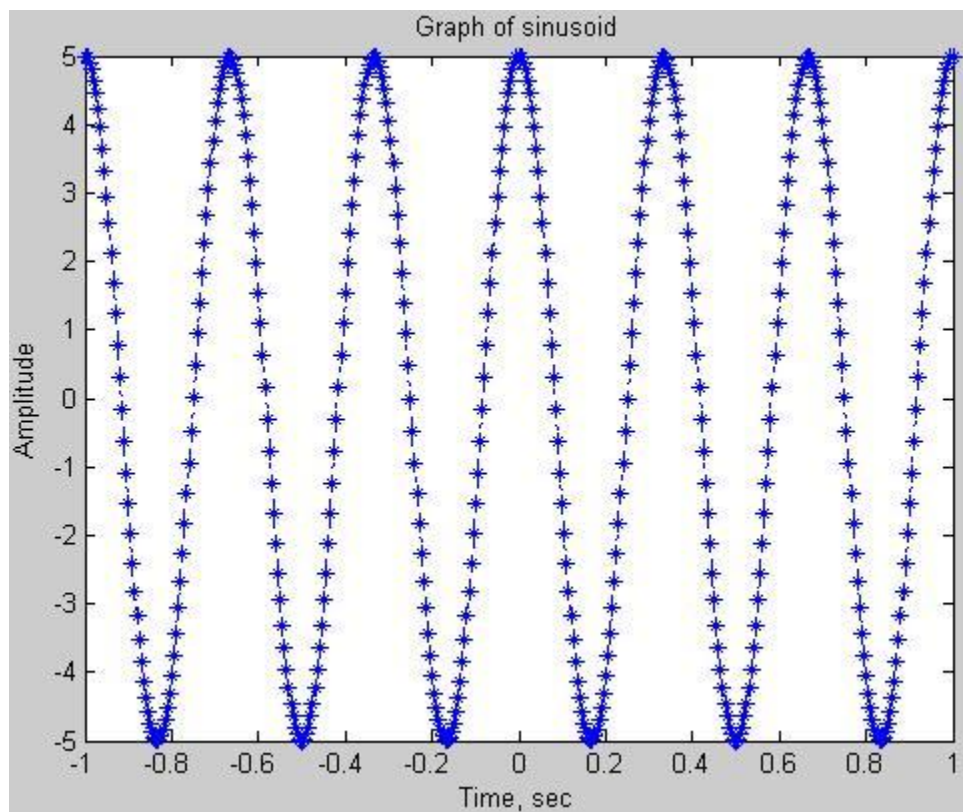
Program: Discrete-Time Sinusoid

```
clc;
clear all;
close all;
M=10; %samples/sec
n=-3:1/M:3;
A=2;
phase=0;
f=1;
x=A * sin(2*pi*f*n + phase);

stem(n,x,'linewidth', 2)
title('Discrete-Time Sine Wave: A sin(2*\pi*f*n +
\phi)')
xlabel('Time Index')
ylabel('Signal Amplitude')
axis([n(1) n(end) -A A])
grid
```
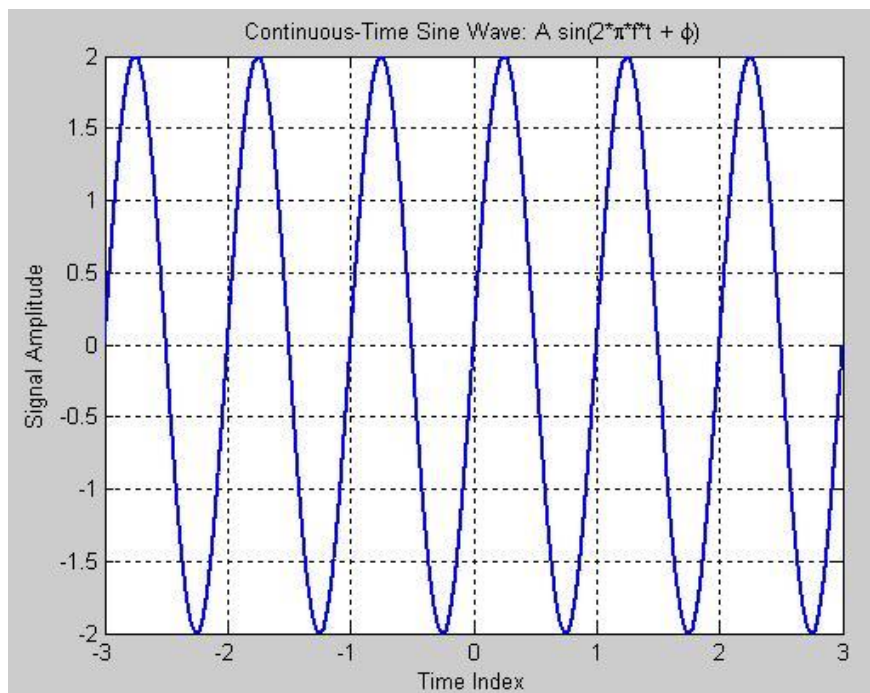
6.2 CREATING PHASE SHIFT

Phase shift can be created by adding an angle to 2πft for a sinusoid.

Example

```
clc;
clear all;
close all;
fs=1000;
t=-3:1/fs:3;
A=2;
phase=0;
f=1;
x=A * sin(2*pi*f*t + phase);

plot(t,x, 'linewidth', 2)
title('Continuous-Time Sine Wave: A sin(2*\pi*f*t +
\phi)')
xlabel('Time Index')
ylabel('Signal Amplitude')
axis([t(1) t(end) -A A])
grid
```

--------------------------TASK 01--------------------------

Generate the 1x10 row vector *v* whose *i*-th component is cos (iπ/4).

--------------------------TASK 02--------------------------

Write matlab code that draw graphs of sin (nπx) on the interval -1≤x≤1 for n = 1, 2, 3, …, 8. (Hint: Use for loop)

--------------------------TASK 03--------------------------

Given the signal exp(-x)sin(8x) for 0≤x≤2π, plot its continuous-time and discrete-time representations. Use subplot and label properly.

--------------------------TASK 04--------------------------

Modify the example given in topic 6.2 to generate a sine wave with phase shift of +pi/2. Then plot a cosine wave of same frequency, amplitude, and phase shift of 0 in another subplot. Compare both the signals and determine the relationship between the two.

--------------------------TASK 05--------------------------

Write a program to generate a continuous-time sine wave of frequency 3 Hz, positive phase shift of pi/2, and amplitude of 5. Also generate a continuous-time cosine wave of frequency 3 Hz, amplitude of 5, and phase shift of 0. Plot the two signals on separate subplots and properly label them. Determine the relationship between the two signals.

6.3   ADDITION OF SINUSOIDS

6.3.1   <u>CASE 1:</u> When Frequency, Phases, and amplitude of the sinusoids are same
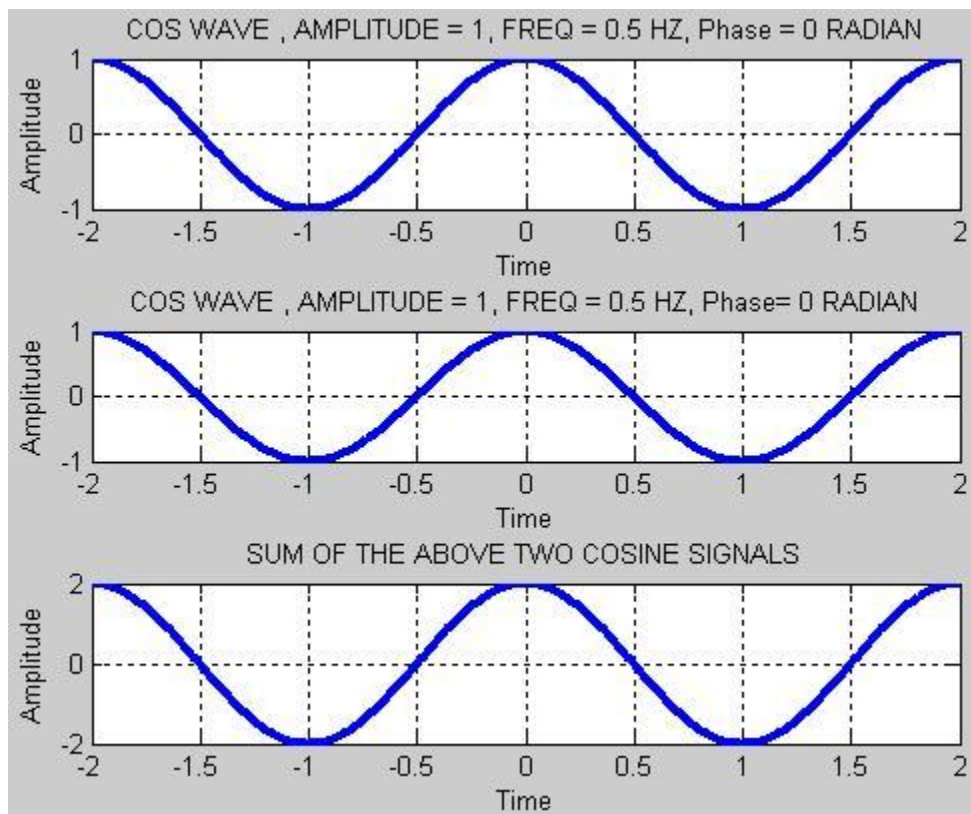
```
clc ;
clear all;
close all;
t=-2:0.01:2;
x1=cos(2*pi*0.5*t);
x2=cos(2*pi*0.5*t);
x3=x1+x2;
subplot(3,1,1);
plot(t,x1,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
```

```
title('COS WAVE , AMPLITUDE = 1, FREQ = 0.5 HZ, Phase = 0
RADIAN');
subplot(3,1,2);
plot(t,x2,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('COS WAVE , AMPLITUDE = 1, FREQ = 0.5 HZ, Phase= 0
RADIAN');
subplot(3,1,3);
plot(t,x3,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('SUM OF THE ABOVE TWO COSINE SIGNALS');
```
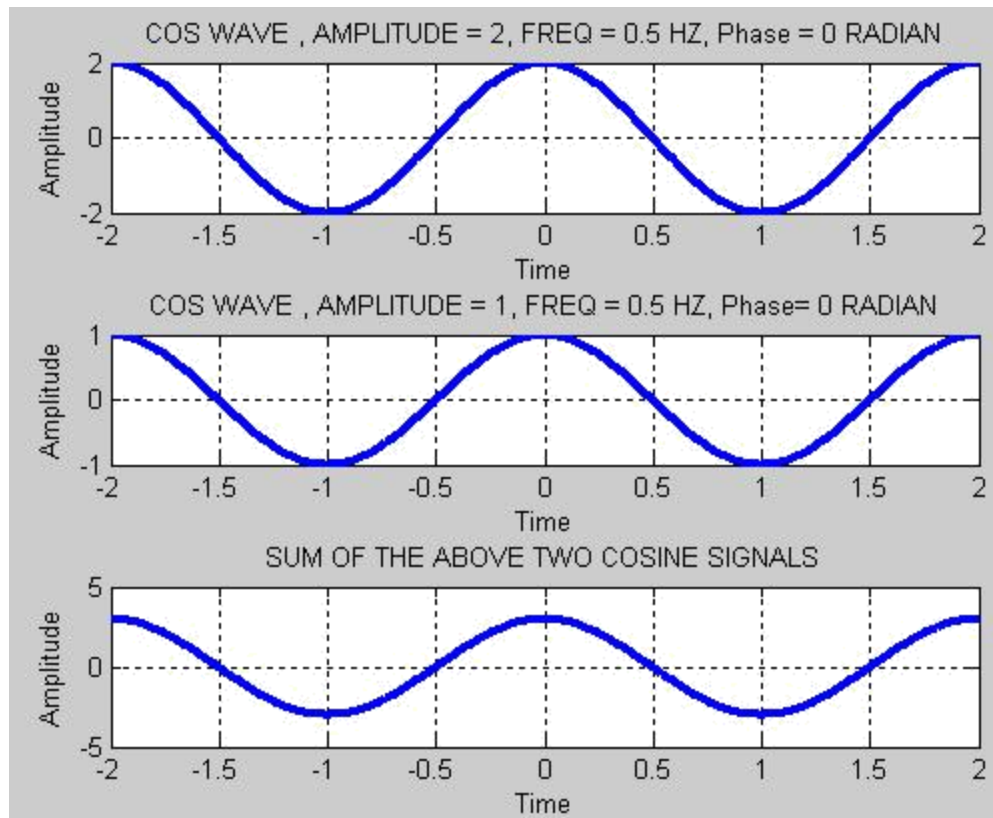

6.3.2 <u>CASE 2:</u> When Frequencies and Phases of the sinusoids are same but Amplitudes are different.

```
t=-2:0.01:2;
```

```matlab
x1=2*cos(2*pi*0.5*t);
x2=cos(2*pi*0.5*t);
x3=x1+x2;
subplot(3,1,1);
plot(t,x1,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('COS WAVE , AMPLITUDE = 2, FREQ = 0.5 HZ, Phase = 0
RADIAN');
subplot(3,1,2);
plot(t,x2,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('COS WAVE , AMPLITUDE = 1, FREQ = 0.5 HZ, Phase= 0
RADIAN');
subplot(3,1,3);
plot(t,x3,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('SUM OF THE ABOVE TWO COSINE SIGNALS');
```
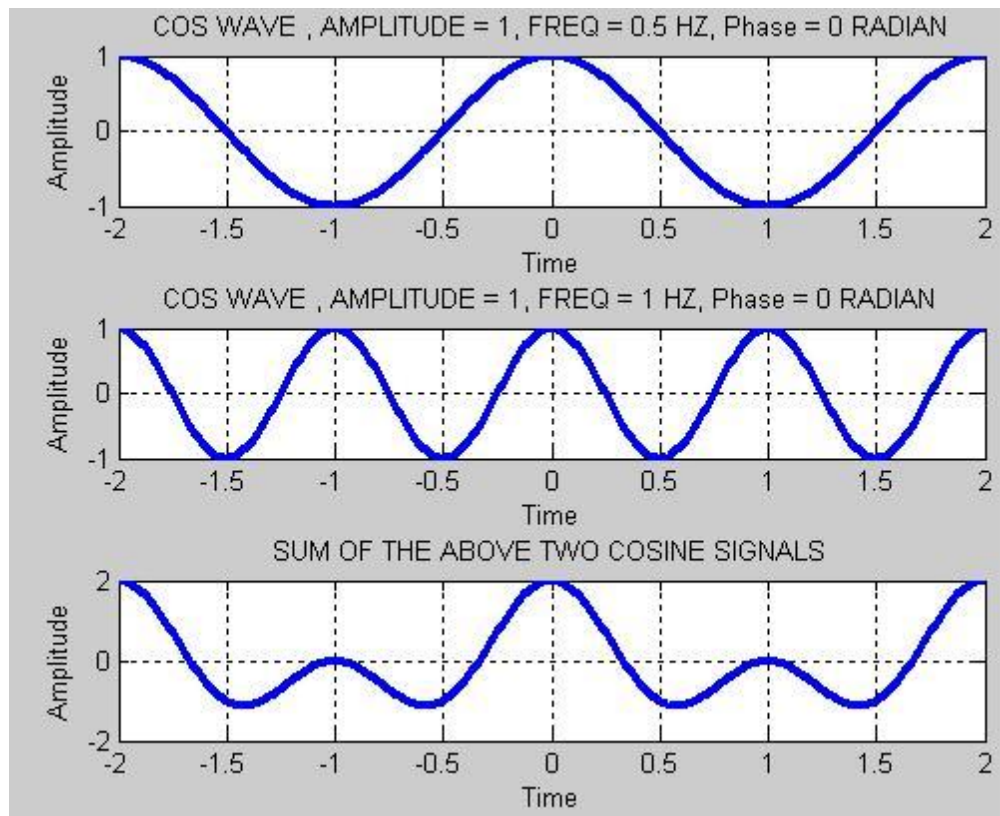
6.3.3 <u>CASE 3:</u> When Amplitudes and Phases of the sinusoids are the same but Frequencies are different.

```
t=-2:0.01:2;
x1=cos(2*pi*0.5*t);
x2=cos(2*pi*1*t);
x3=x1+x2;
subplot(3,1,1);
plot(t,x1,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('COS WAVE , AMPLITUDE = 1, FREQ = 0.5 HZ, Phase = 0
RADIAN');
subplot(3,1,2);
plot(t,x2,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
```

```
title('COS  WAVE  ,  AMPLITUDE  =  1,  FREQ  =  1  HZ,  Phase  =  0
RADIAN');
subplot(3,1,3);
plot(t,x3,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('SUM OF THE ABOVE TWO COSINE SIGNALS');
```


6.3.4 <u>CASE 4</u>: When Amplitudes and Frequencies of the sinusoids are the same but Phases are different

```
t=-2:0.01:2;
x1=cos(2*pi*0.5*t);
x2=cos((2*pi*0.5*t)+1);
x3=x1+x2;
subplot(3,1,1);
plot(t,x1,'linewidth',3);
grid;
ylabel('Amplitude');
```

```
xlabel('Time');
title('COS WAVE , AMPLITUDE = 1, FREQ = 0.5 HZ, Phase = 0
RADIAN');
subplot(3,1,2);
plot(t,x2,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('COS WAVE , AMPLITUDE = 1, FREQ = 0.5 HZ, Phase = 1
RADIAN');
subplot(3,1,3);
plot(t,x3,'linewidth',3);
grid;
ylabel('Amplitude');
xlabel('Time');
title('SUM OF THE ABOVE TWO COSINE SIGNALS');
```
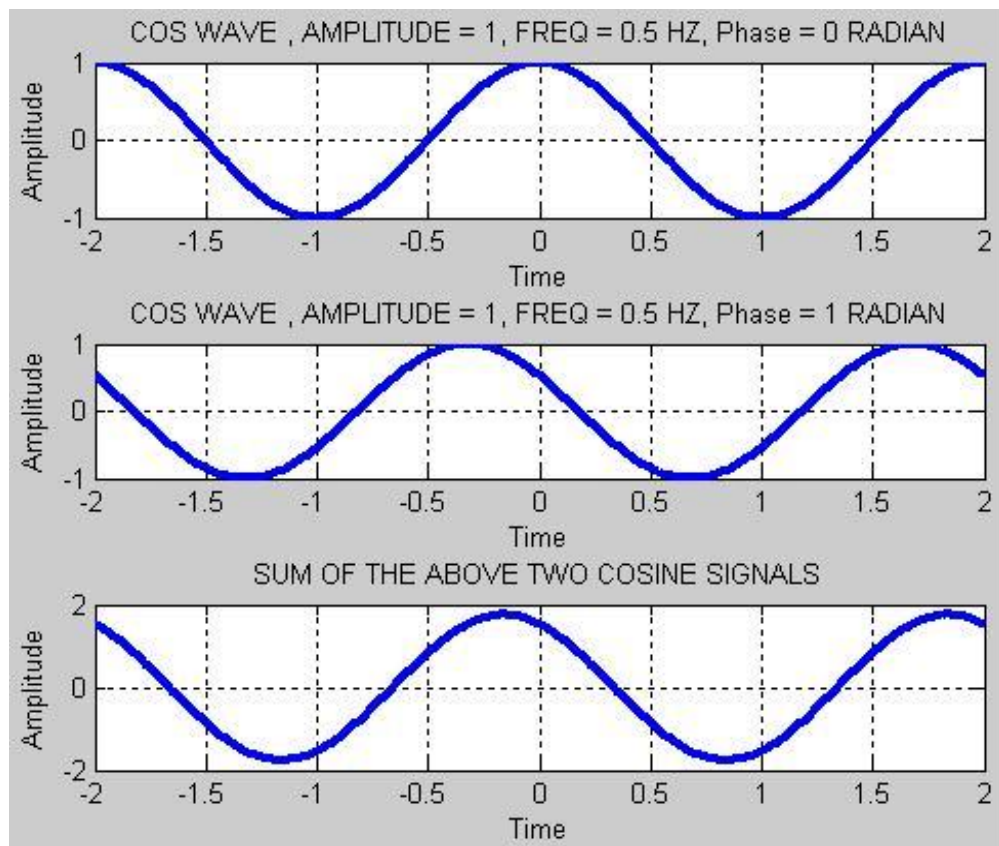
-------------------------TASK 06-------------------------

Write a general program that takes 'n' sinusoids from user of same frequency, amplitude, and phase. Plot the individual sinusoids & the resultant using subplot function on same figure. Do perform proper labeling. Note: Take the amplitude, frequency, and phase given in example of case 1. Run the code for different values of n and state the result on paper.

-------------------------TASK 07-------------------------

Write a general program that takes 'n' sinusoids from user of same frequency and phase with varying amplitudes. Take amplitude from user on run time. Plot the individual sinusoids & the resultant using subplot function on same figure. Do perform proper labeling. Note: Take the amplitude and frequency given in example of case 2. Run the code for different values of n and state the result on paper.

-------------------------TASK 08-------------------------

Write a general program that takes 'n' sinusoids from user of same amplitude and phase with varying frequencies. Take each frequency from user on run time. Plot the individual sinusoids & the resultant using subplot function on same figure. Do perform proper labeling. Note: Take the amplitude and phase given in example of case 3. Run the code for different values of n and state the result on paper.

-------------------------TASK 09-------------------------

Write a general program that takes 'n' sinusoids from user of same amplitude and frequency with varying phases. Take each phase from user on run time. Plot the individual sinusoids & the resultant using subplot function on same figure. Do perform proper labeling. Note: Take the amplitude and frequency given in example of case 4. Run the code for different values of n and state the result on paper.

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