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LAB 3

Compute and plot the amplitude spectrum |X(f)| and the phase spectrum X(f) over f within [-0.5,0.5] under various choices of f, a and phase angle

1) For variety values of f0 within (0,0.5)
   f=0.5

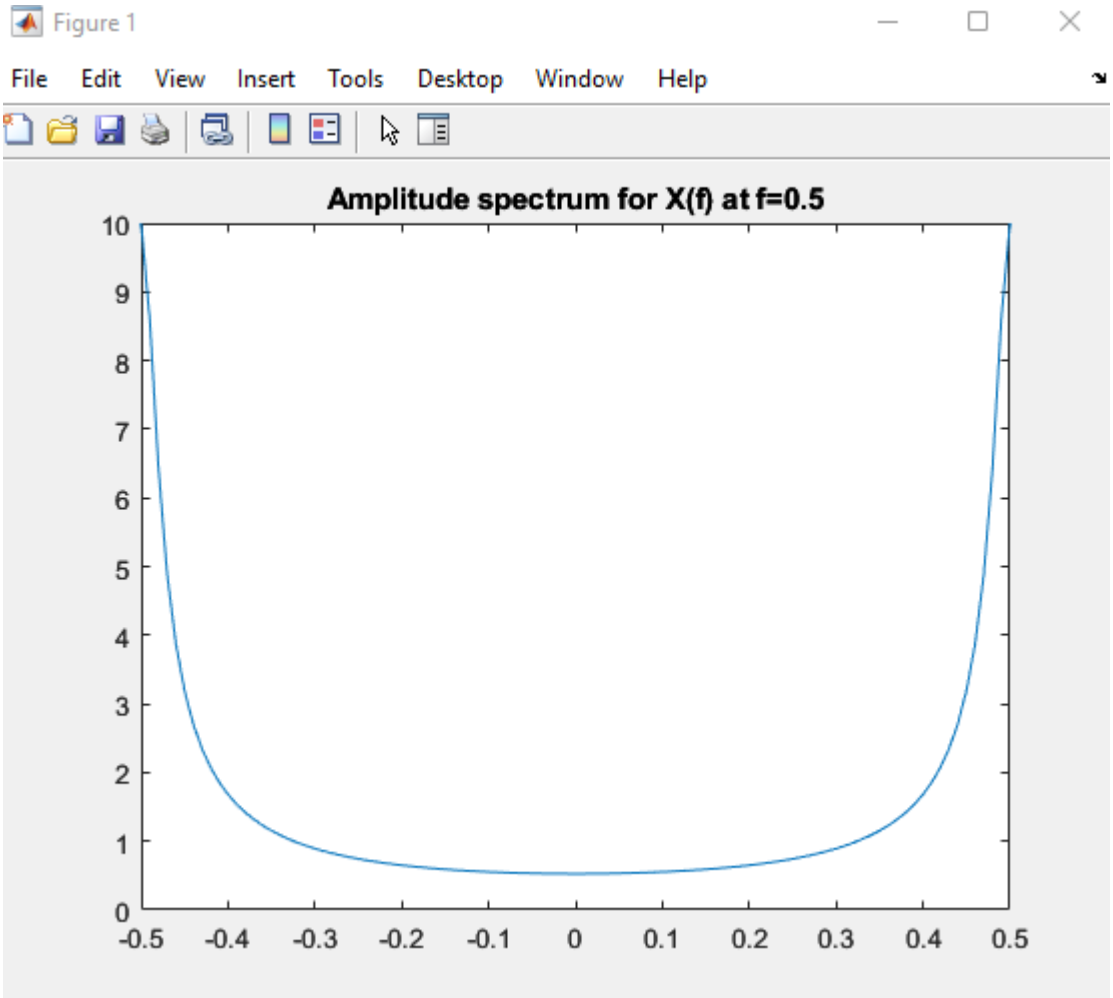
   For coding part:

Editor - C:\Users\thong\Downloads\lab3_ee110b.m

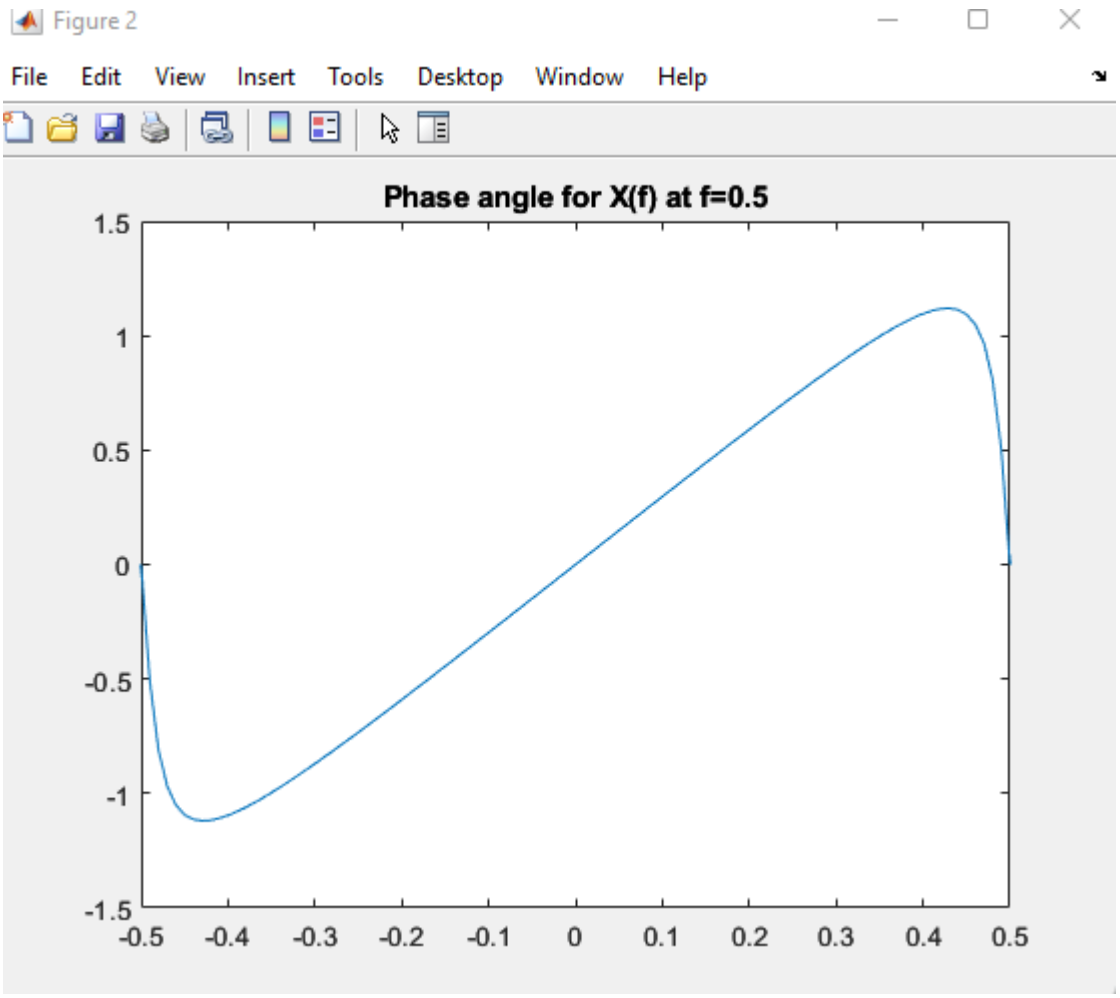
EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m

```
1   n=0:200;
2   f0= 0.5;
3   a=0.9;
4   theta= 0;
5   x=a.^n.*cos(2*pi*f0*n);
6   z=zeros(101,1);
7   for k=-50:50
8       z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
9   end
10  f=-0.5:0.01:0.5;
11  figure(1)
12  plot(f,abs(z));
13  title('Amplitude spectrum for X(f) at f=0.5');
14
15  %angle
16  figure(2)
17  plot(f,angle(z));
18  title('Phase angle for X(f) at f=0.5');
19
```

   For the amplitude spectrum for X(f):



For the phase spectrum X(f)



+ **f=0:**

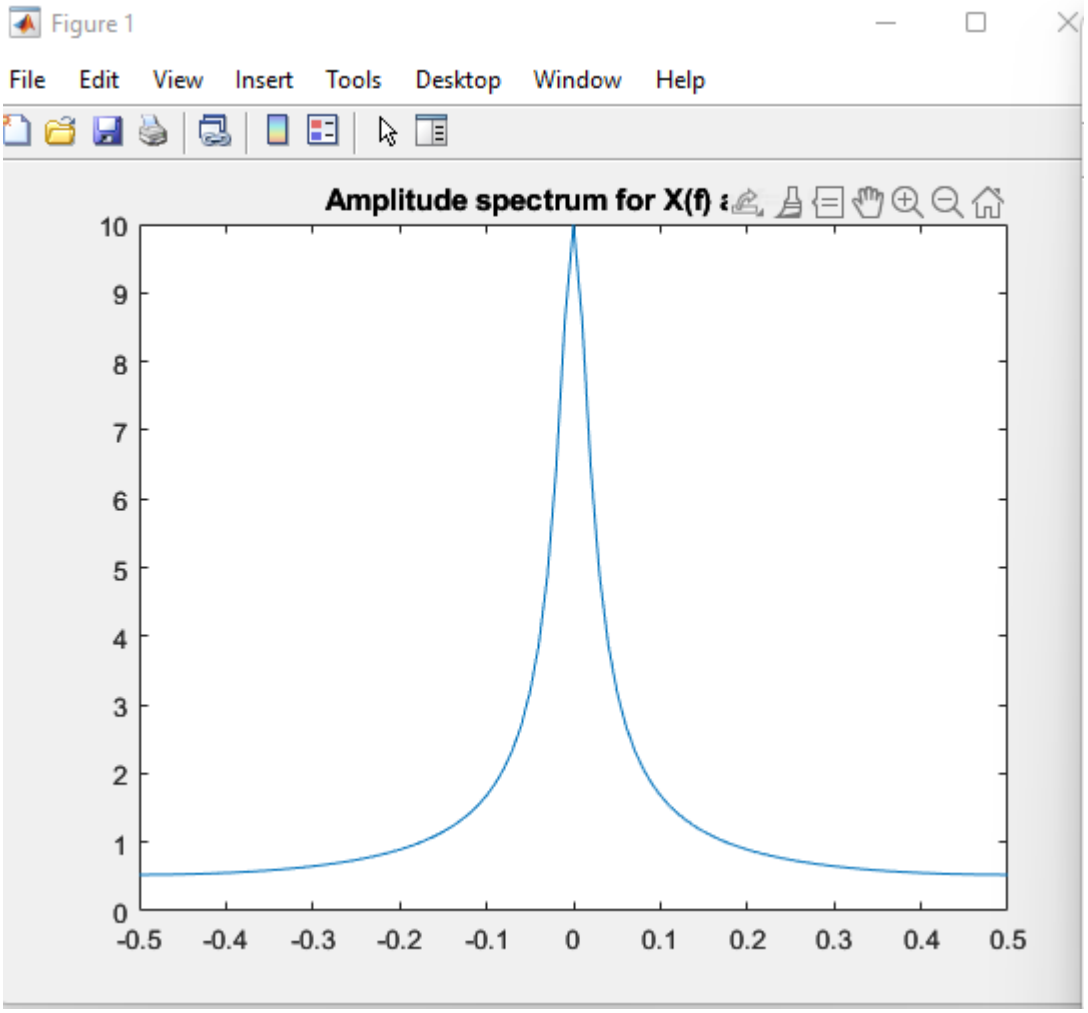
  For coding part:

Editor - C:\Users\thong\Downloads\lab3_ee110b.m

EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m

```
n=0:200;
f0= 0;
a=0.9;
theta= 0;
x=a.^n.*cos(2*pi*f0*n);
z=zeros(101,1);
for k=-50:50
    z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
end
f=-0.5:0.01:0.5;
figure(1)
plot(f,abs(z));
title('Amplitude spectrum for X(f) at f=0.5');

%angle
figure(2)
plot(f,angle(z));
title('Phase angle for X(f) at f=0.5');

```

For the amplitude spectrum:



For the phase spectrum:

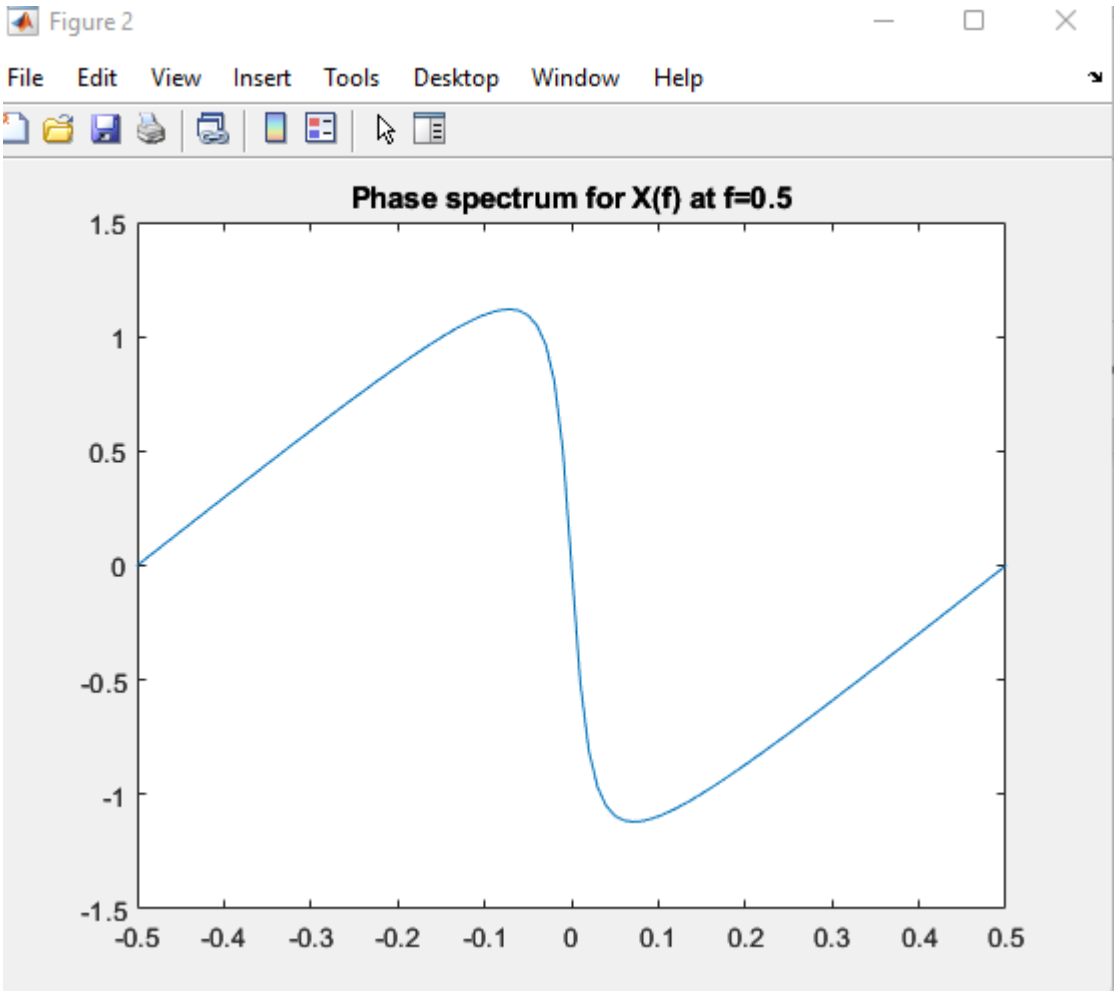


Figure 2
File Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at f=0.5
1.5
1
0.5
0
-0.5
-1
-1.5
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

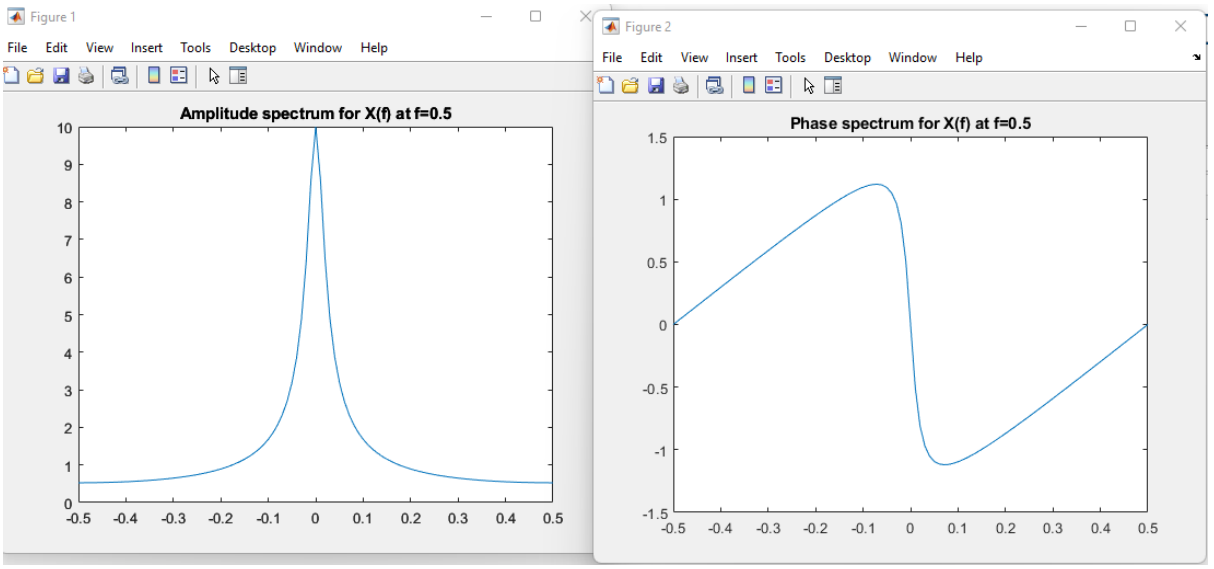
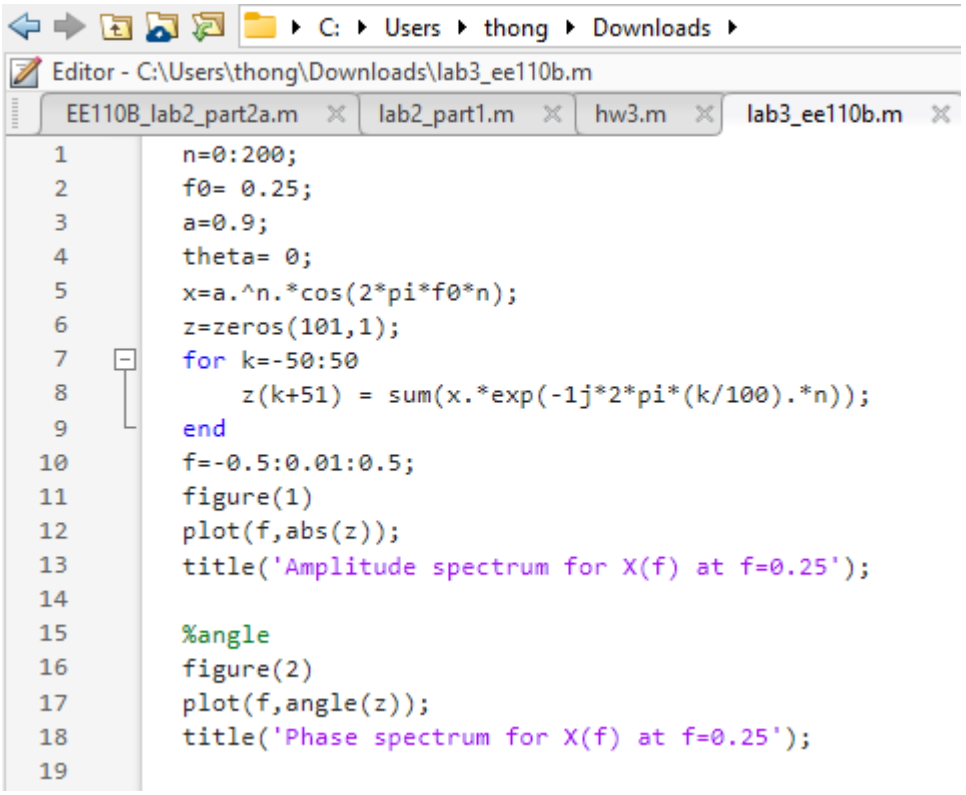


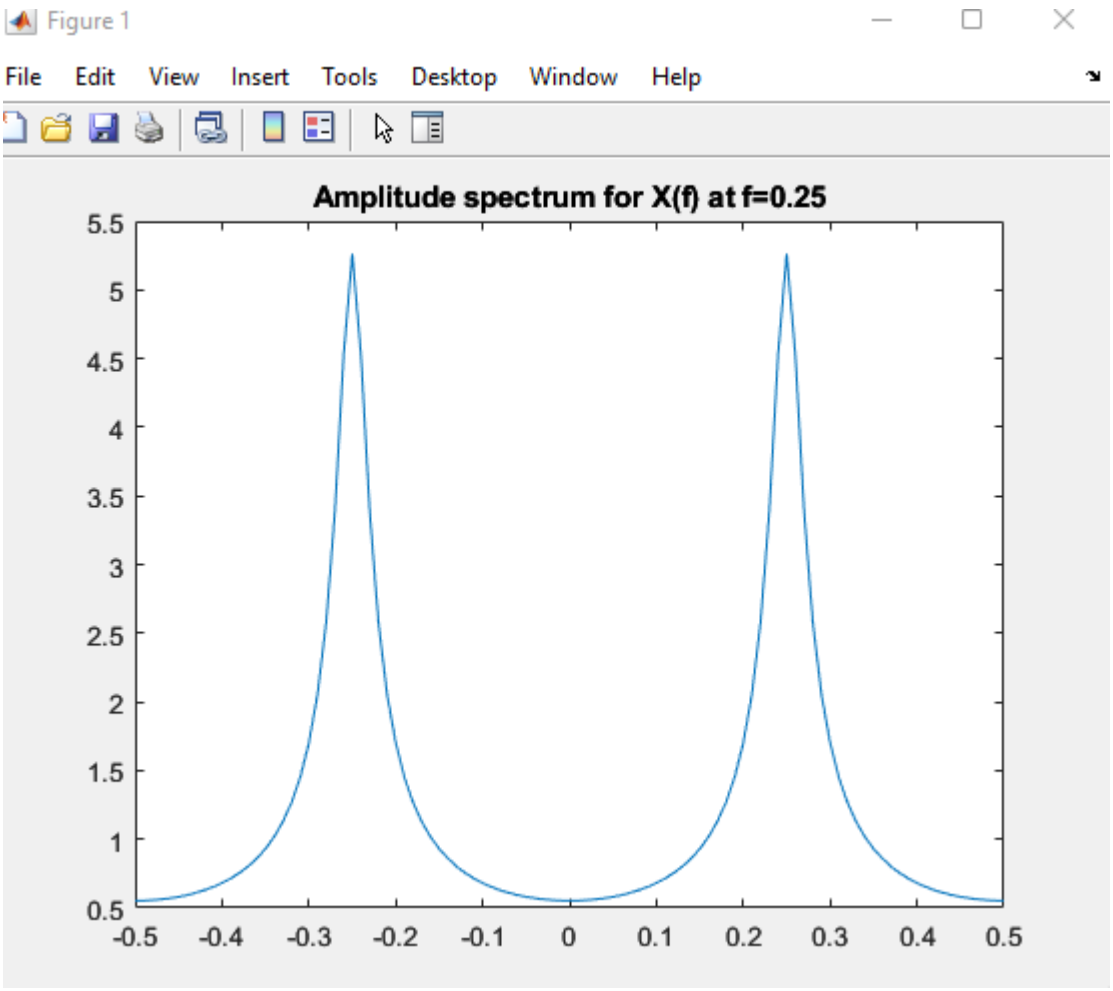
Figure 1
File Edit View Insert Tools Desktop Window Help
Amplitude spectrum for X(f) at f=0.5
10
9
8
7
6
5
4
3
2
1
0
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5
Figure 2
File Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at f=0.5
1.5
1
0.5
0
-0.5
-1
-1.5
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

+f=0.25:

For coding part:



For amplitude spectrum X(f):



For phase spectrum of X(f):

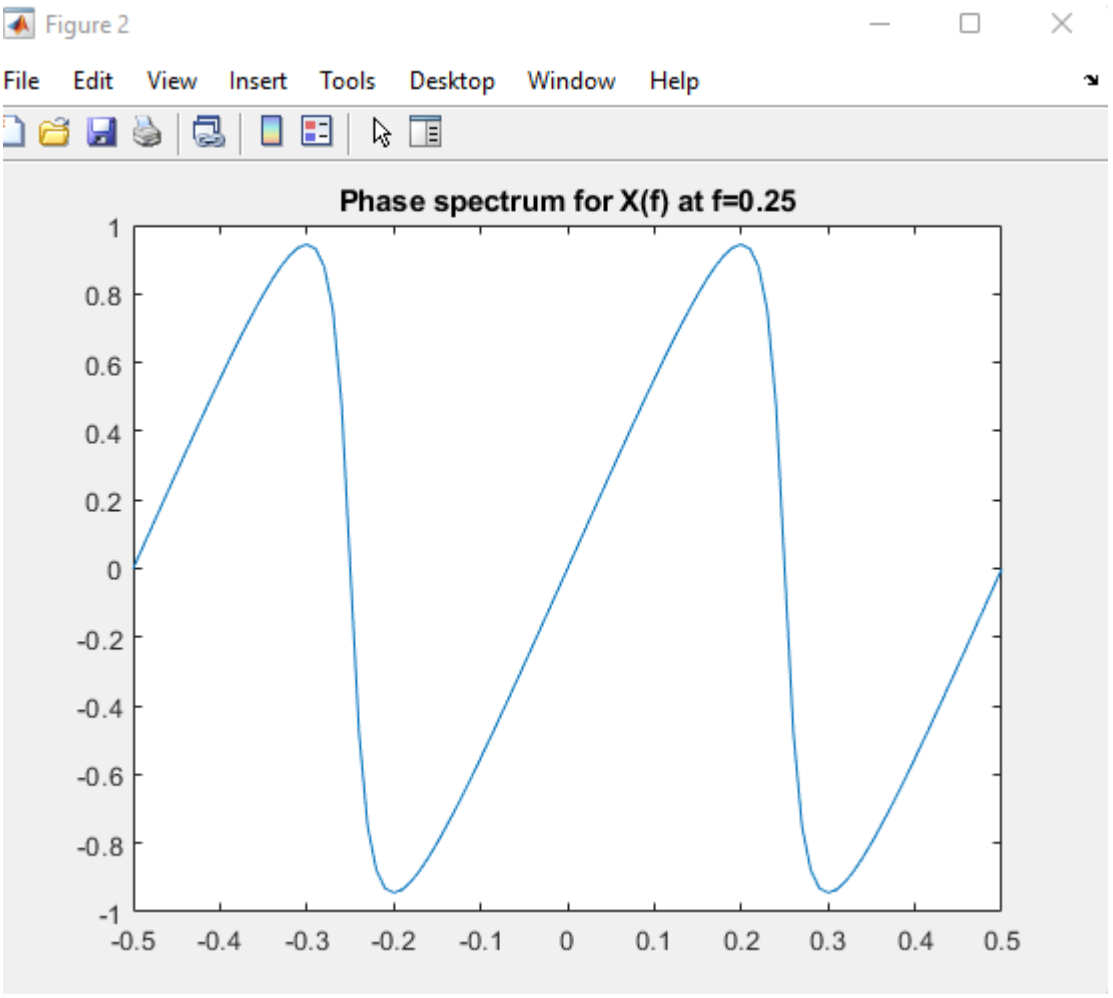


Figure 2
File Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at f=0.25
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

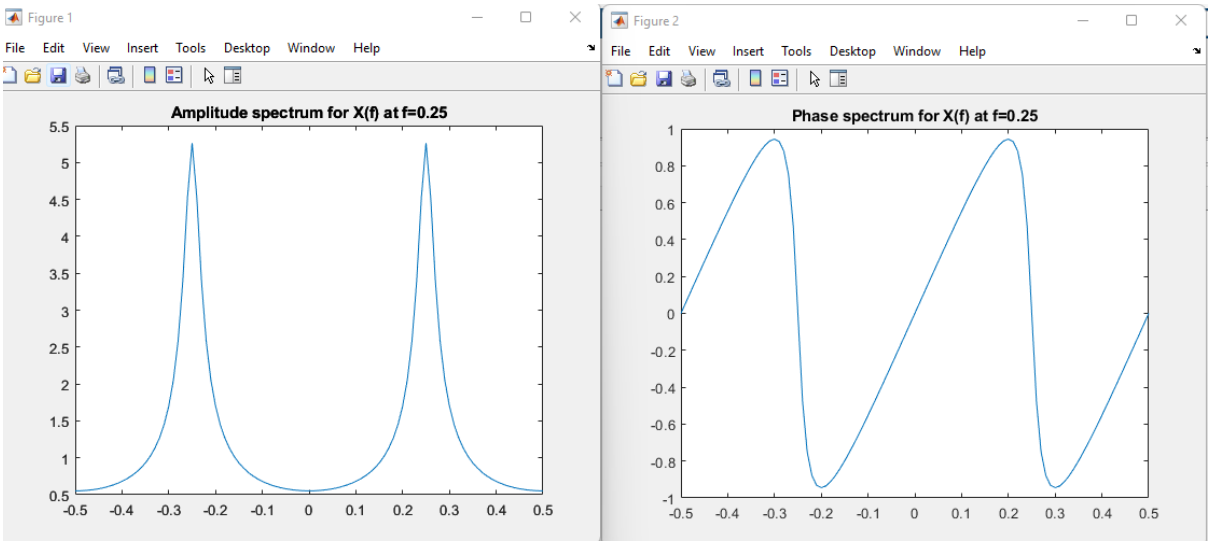


Figure 1
File Edit View Insert Tools Desktop Window Help
Amplitude spectrum for X(f) at f=0.25
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5
Figure 2
File Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at f=0.25
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

The effect of these parameters when f0 changes from 0 to 0.5 is

For the amplitude spectrum, the amplitude **increases** causing the whole graph to start to stretch out

For the phase spectrum, as similar to the amplitude spectrum, the phase increases causing the whole phase spectrum stretching out in the horizontal axis . So the phase spectrum **is increasing** when the value of frequency changes.

2)

f0=0.2, phase angle=0; a is within 0,1

When **a=0;**

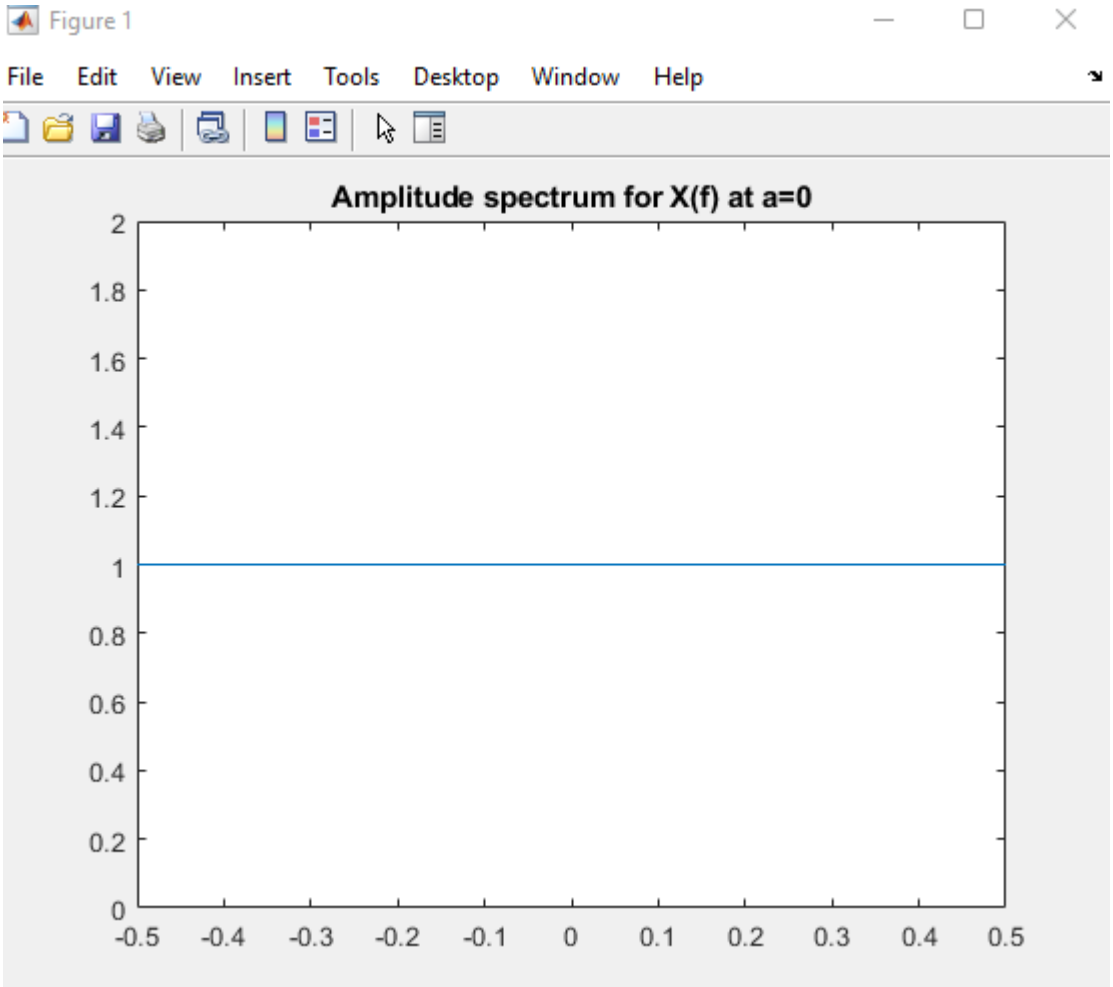
For the coding part:

Editor - C:\Users\thong\Downloads\LAB3_PART2_EE110B.m

EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m

```
clear;;clc;close all;
n=0:200;
f0= 0.2;
a=0;
theta= 0;
x=a.^n.*cos(2*pi*f0*n);
z=zeros(101,1);
for k=-50:50
    z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
end
f = -0.5:0.01:0.5;
figure(1);
plot(f,abs(z));
title('Amplitude spectrum for X(f) at a=0');


%angle
figure(2);
plot(f,angle(z));
title('Amplitude spectrum for X(f) at a=0');

```

For the amplitude spectrum:



For the phase spectrum:

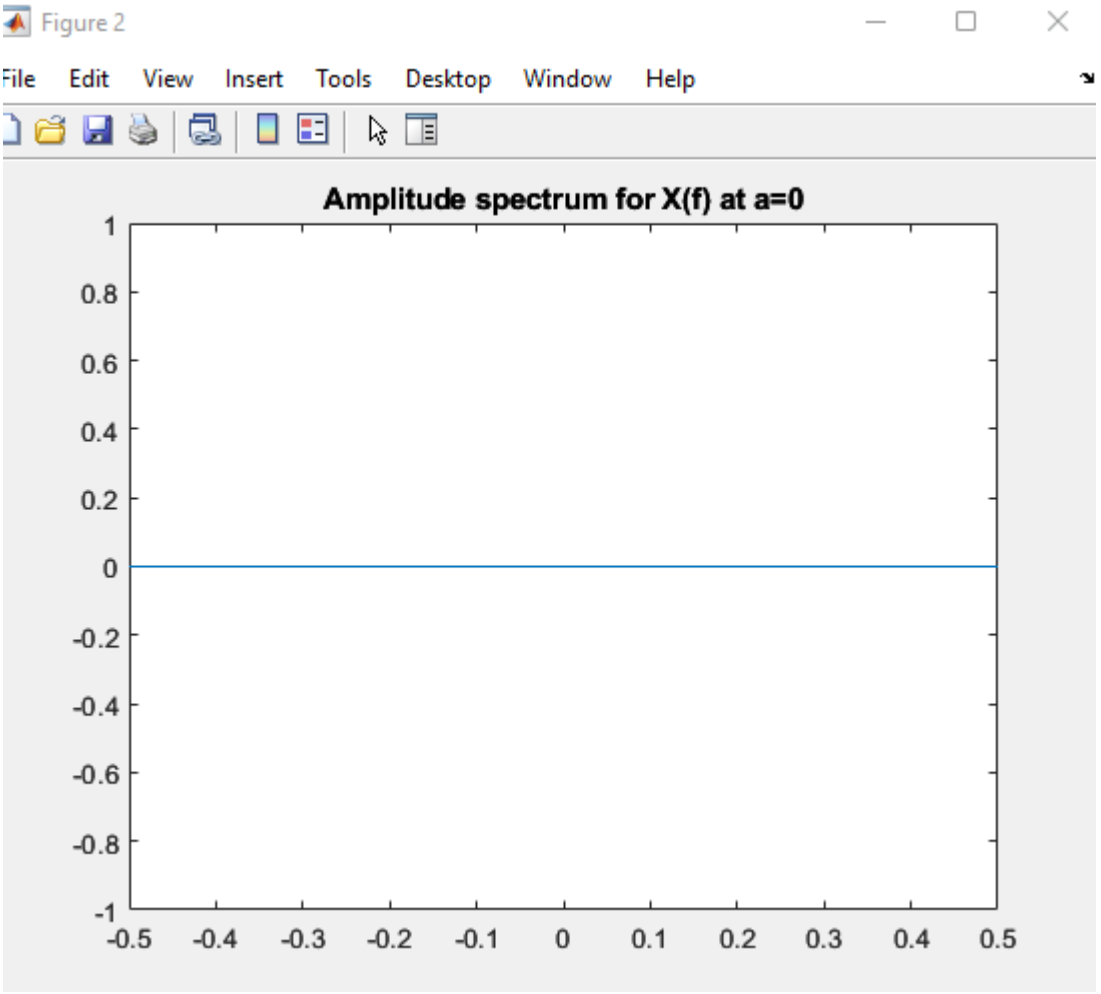


Figure 2
File Edit View Insert Tools Desktop Window Help
Amplitude spectrum for X(f) at a=0
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

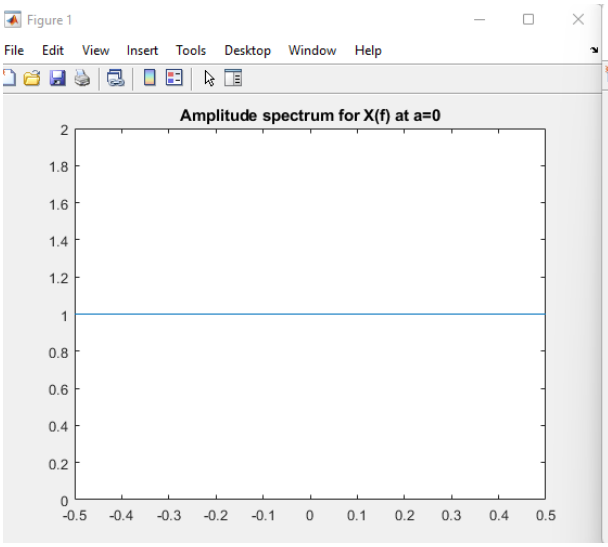


Figure 1
File Edit View Insert Tools Desktop Window Help
Amplitude spectrum for X(f) at a=0
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

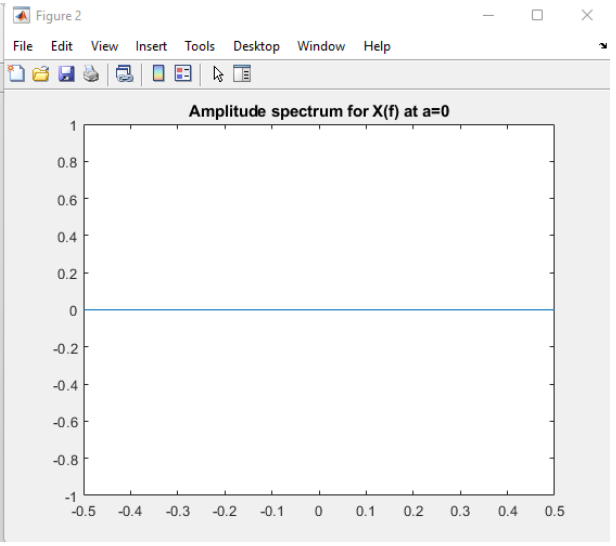


Figure 2
File Edit View Insert Tools Desktop Window Help
Amplitude spectrum for X(f) at a=0
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

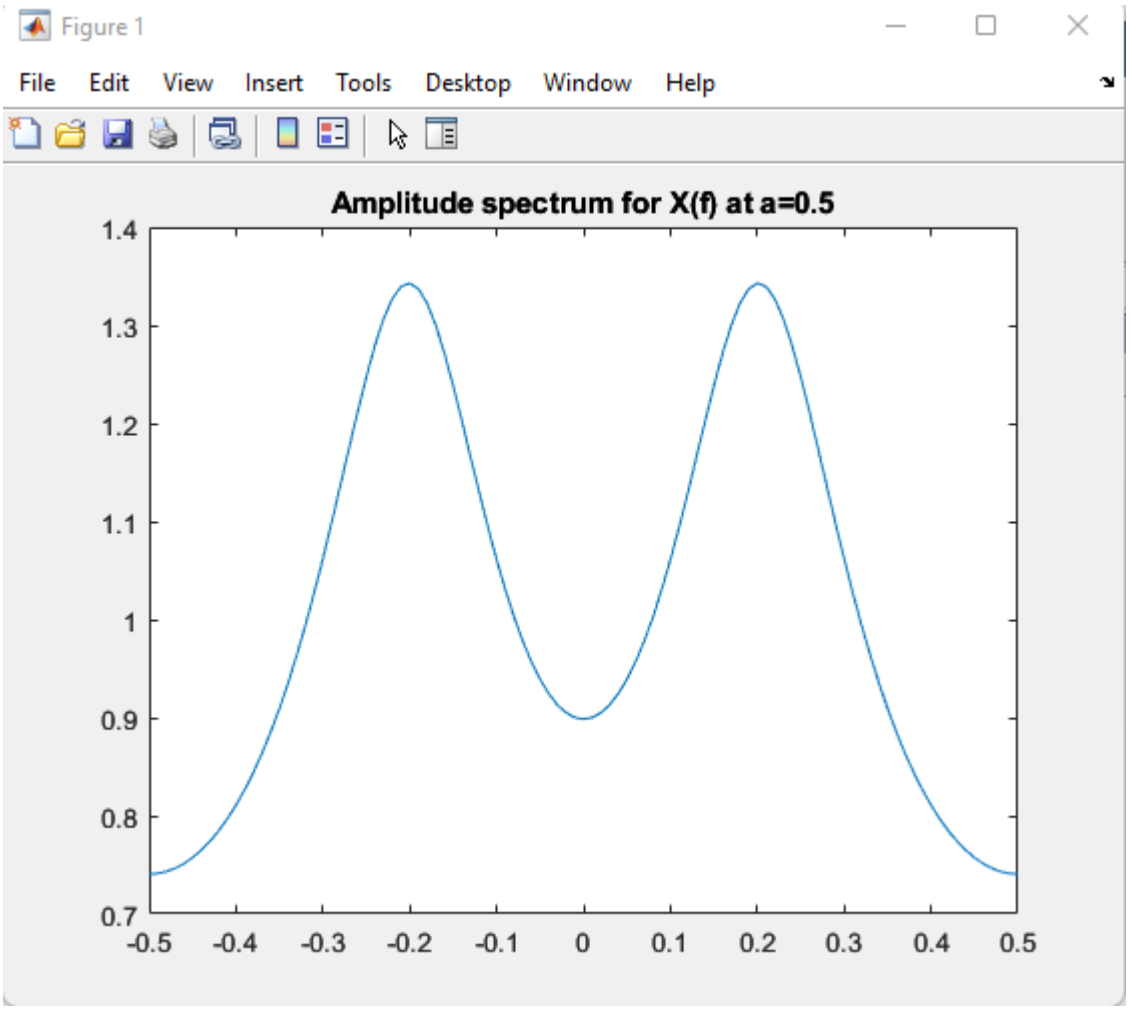
When **a= 0.5:**

For the coding part:

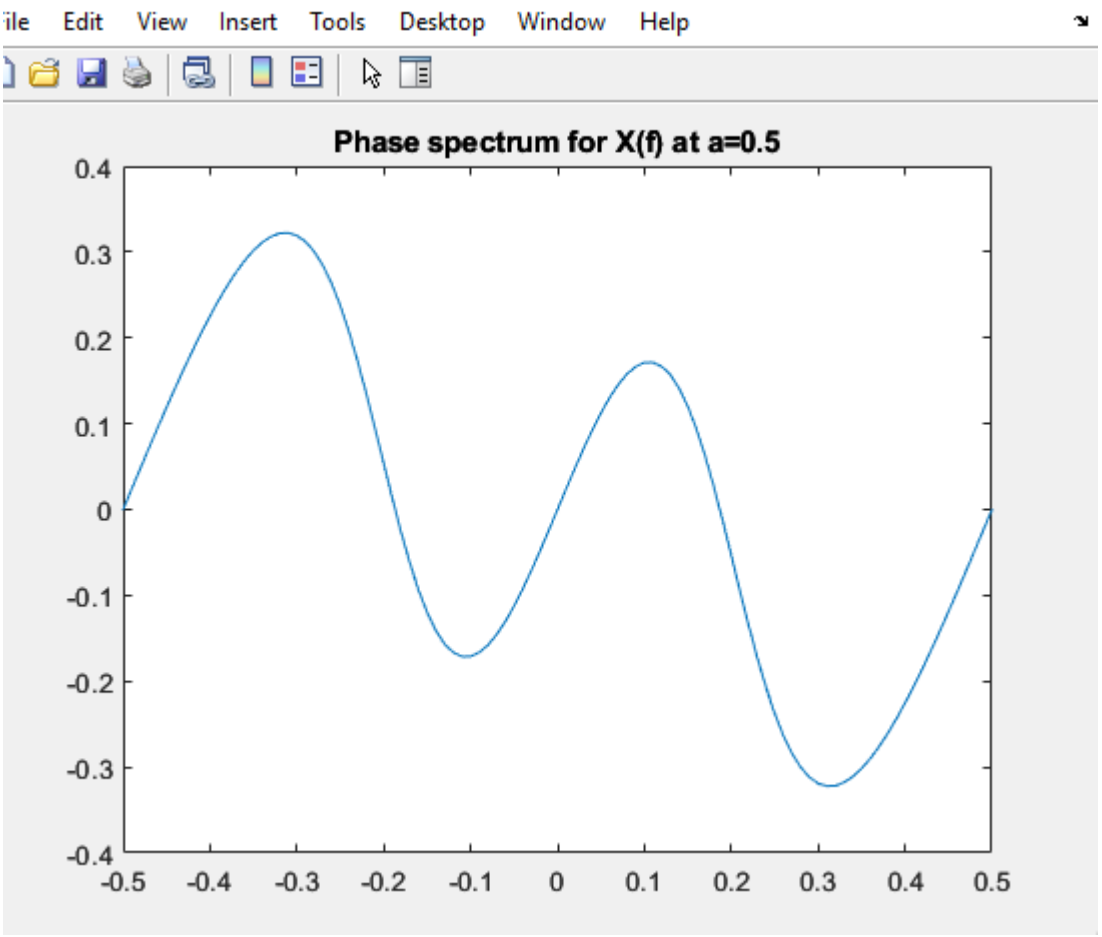
EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m | LAE

```
clear;;clc;close all;
n=0:200;
f0= 0.2;
a=0.5;
theta= 0;
x=a.^n.*cos(2*pi*f0*n);
z=zeros(101,1);
for k=-50:50
    z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
end
f = -0.5:0.01:0.5;
figure(1);
plot(f,abs(z));
title('Amplitude spectrum for X(f) at a=0.5');


%angle
figure(2);
plot(f,angle(z));
title('Amplitude spectrum for X(f) at a=0.5');

```

For the amplitude spectrum:



For the phase spectrum:


ile Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at a=0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

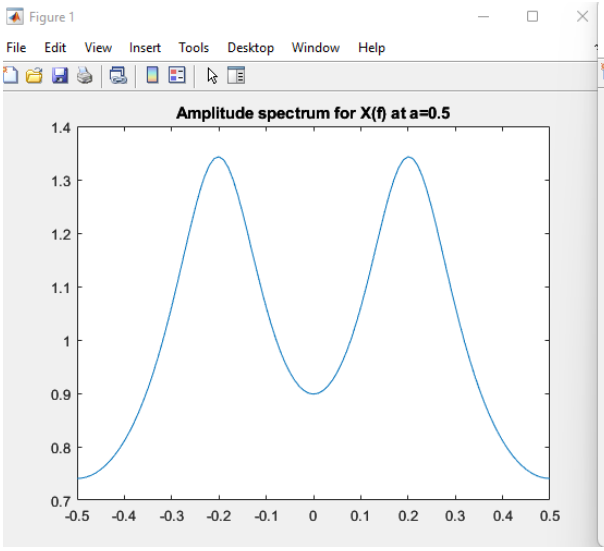


Figure 1
File Edit View Insert Tools Desktop Window Help
Amplitude spectrum for X(f) at a=0.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

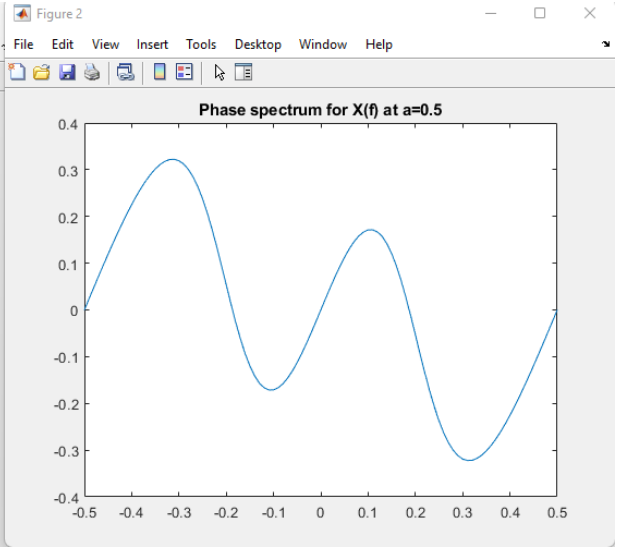
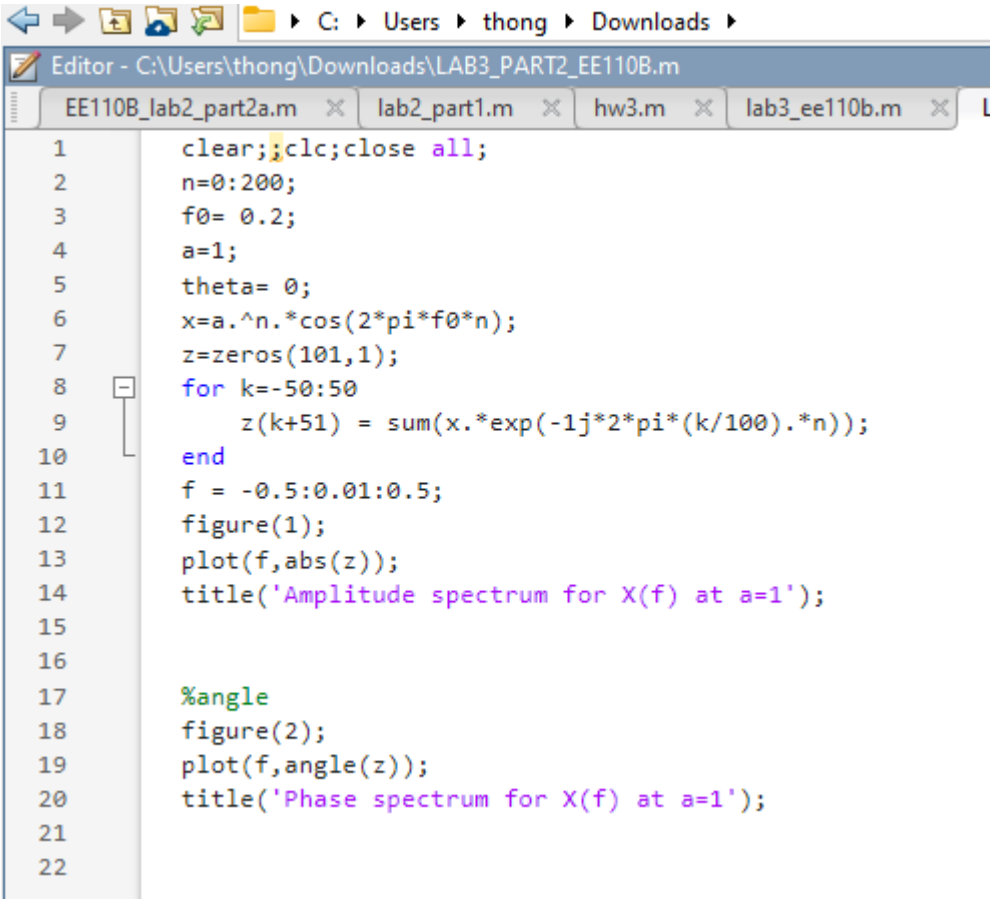


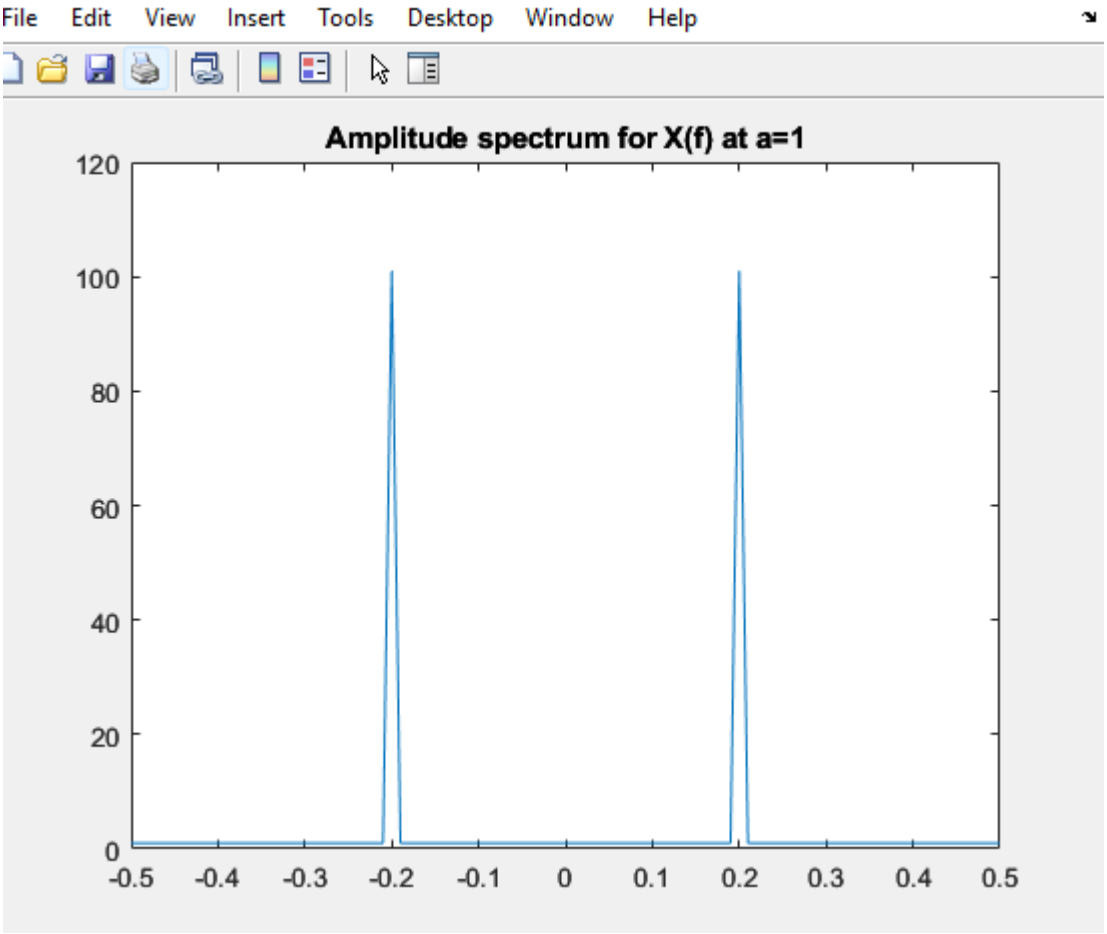
Figure 2
File Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at a=0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

When **a = 1:**

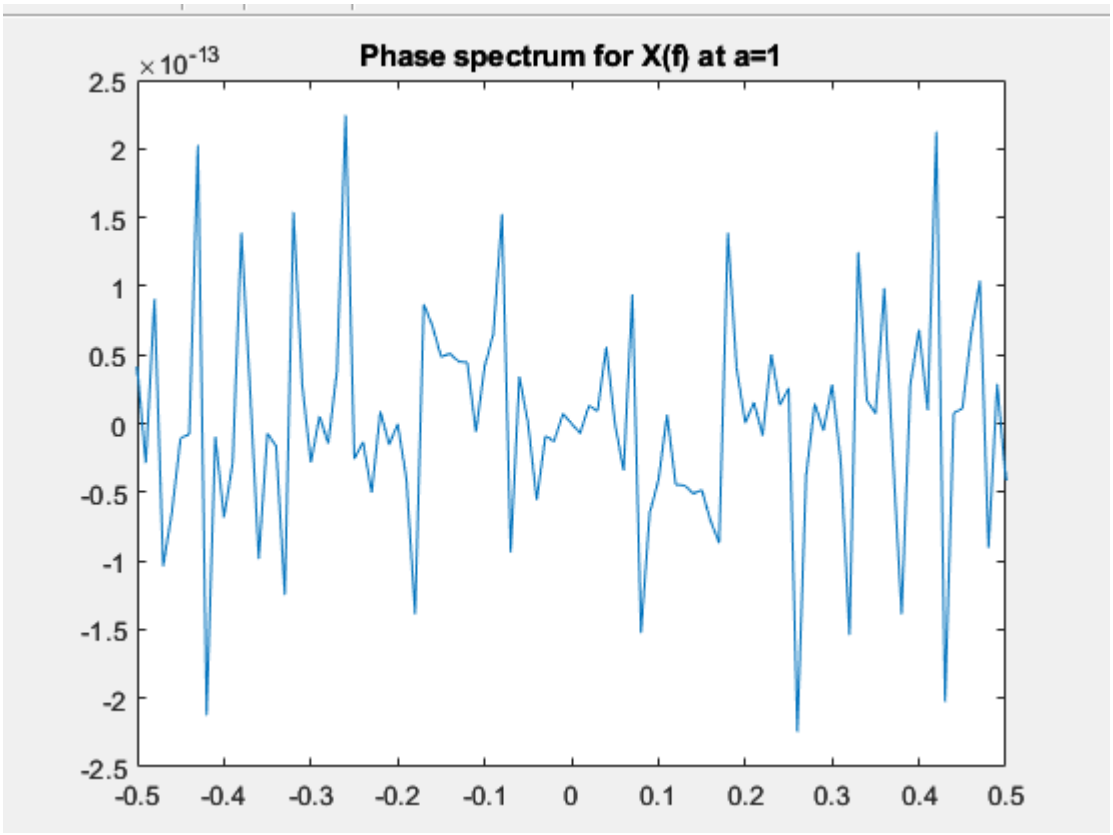
For the coding part:

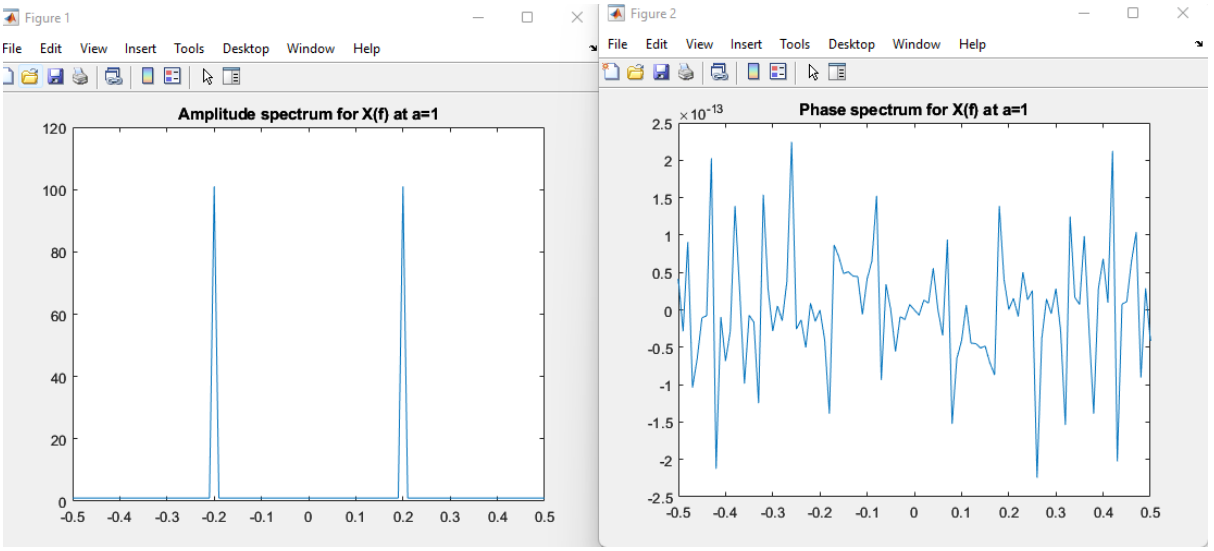


For the amplitude spectrum:



For the phase spectrum:

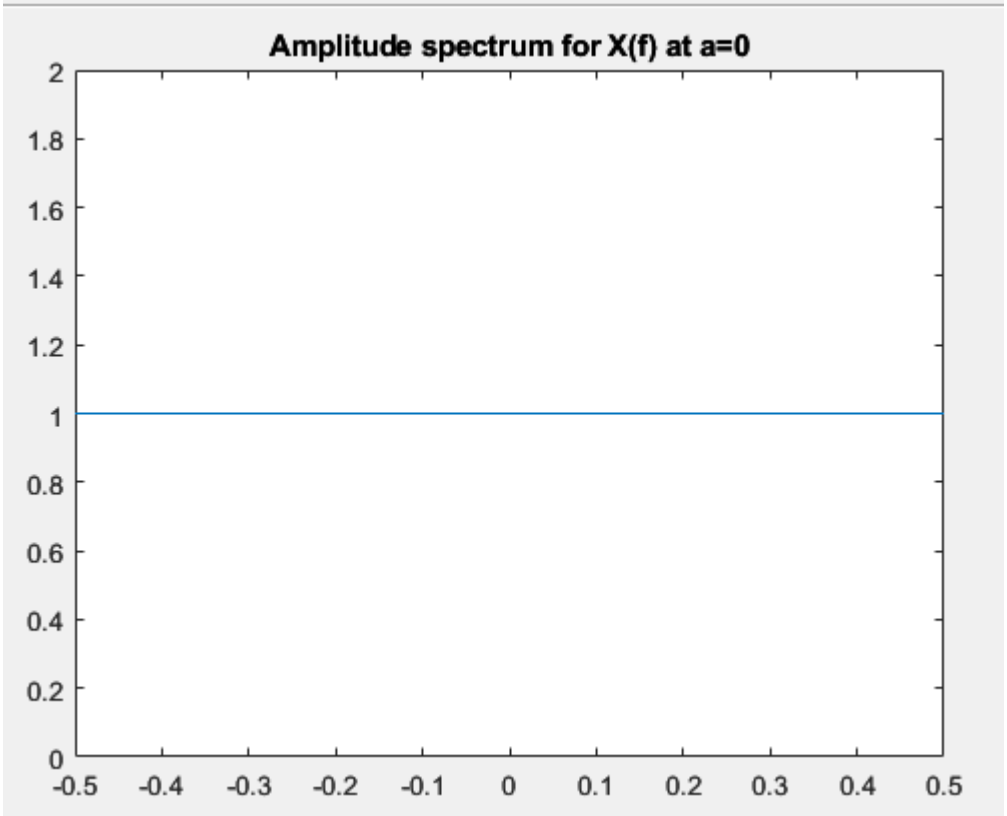


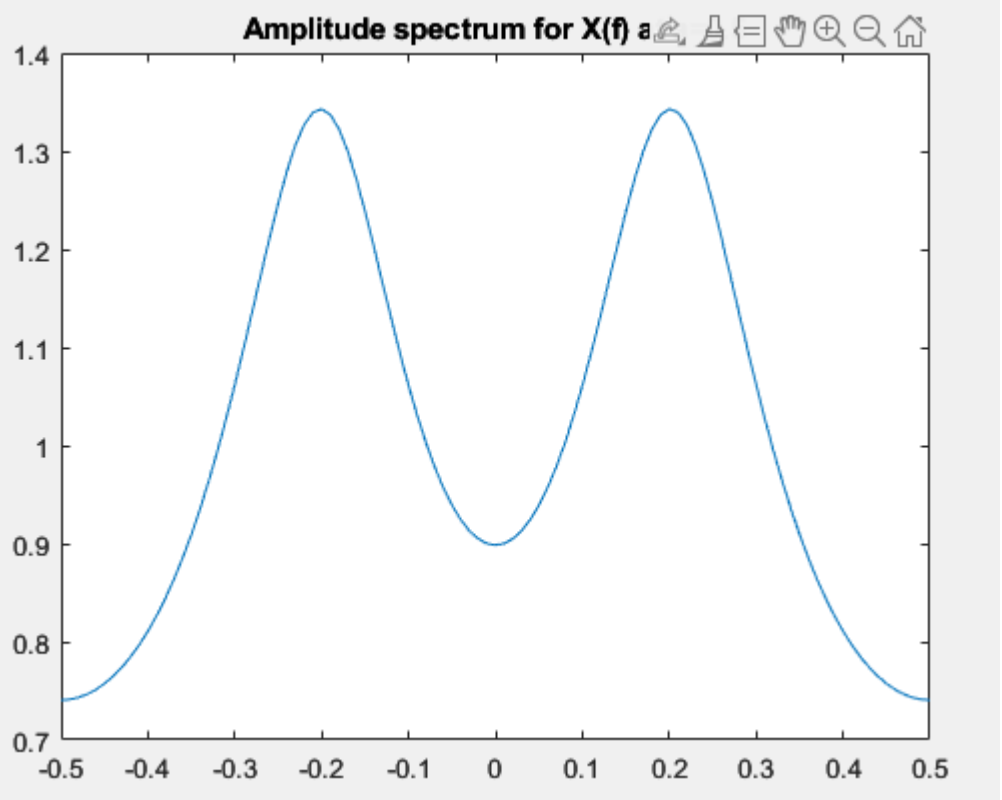


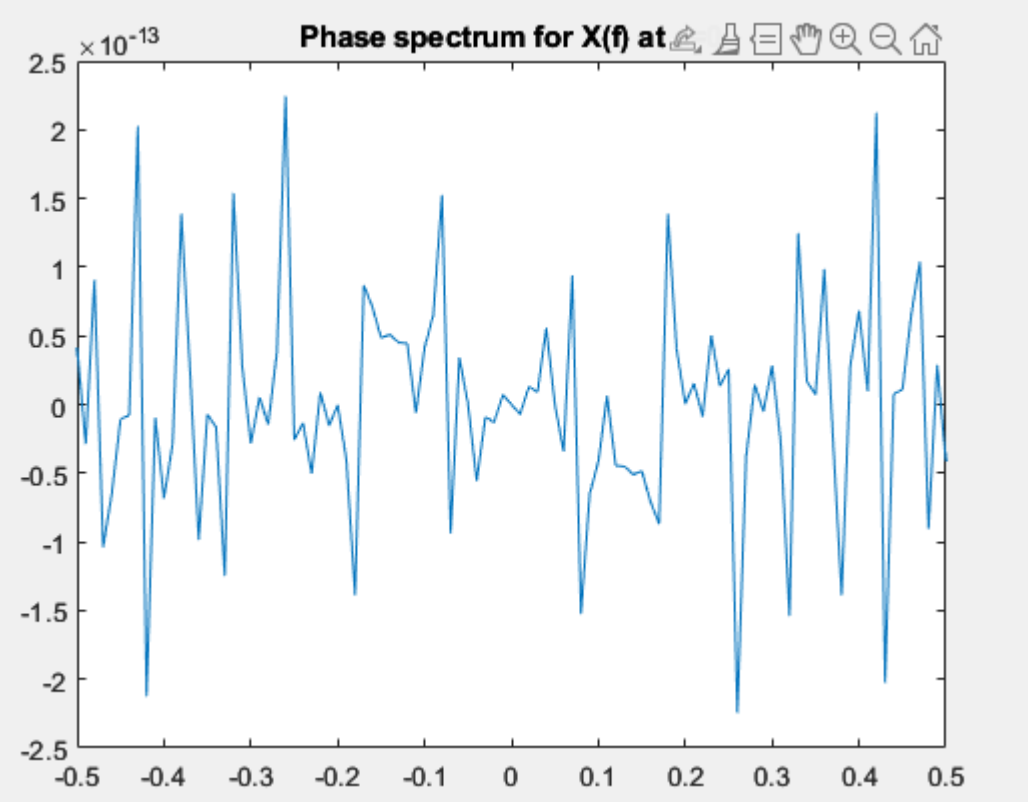
The effect of these parameters when a change from 0 to 1 is

For the amplitude spectrum, the amplitude **is shrinking** as the value of (a) increases. When a=0, the amplitude of the graph is 0; when a=0.5, the amplitude

started to shrink down, and the slope started to increase; when a=1, the amplitude is shrinking by a large amount, and the slope is super steep.







For the phase spectrum, the phase **is also shrinking** as well when the value of (a) is expanding. When a=0 , the phase is on the horizontal line. When a=0.5, the phase is starting to shrink down with the tip is around 0.32, and the slope is not too steep. When a=1, the phase started to shrink down , the slope of the graph is super steep with the tip is around 2.25

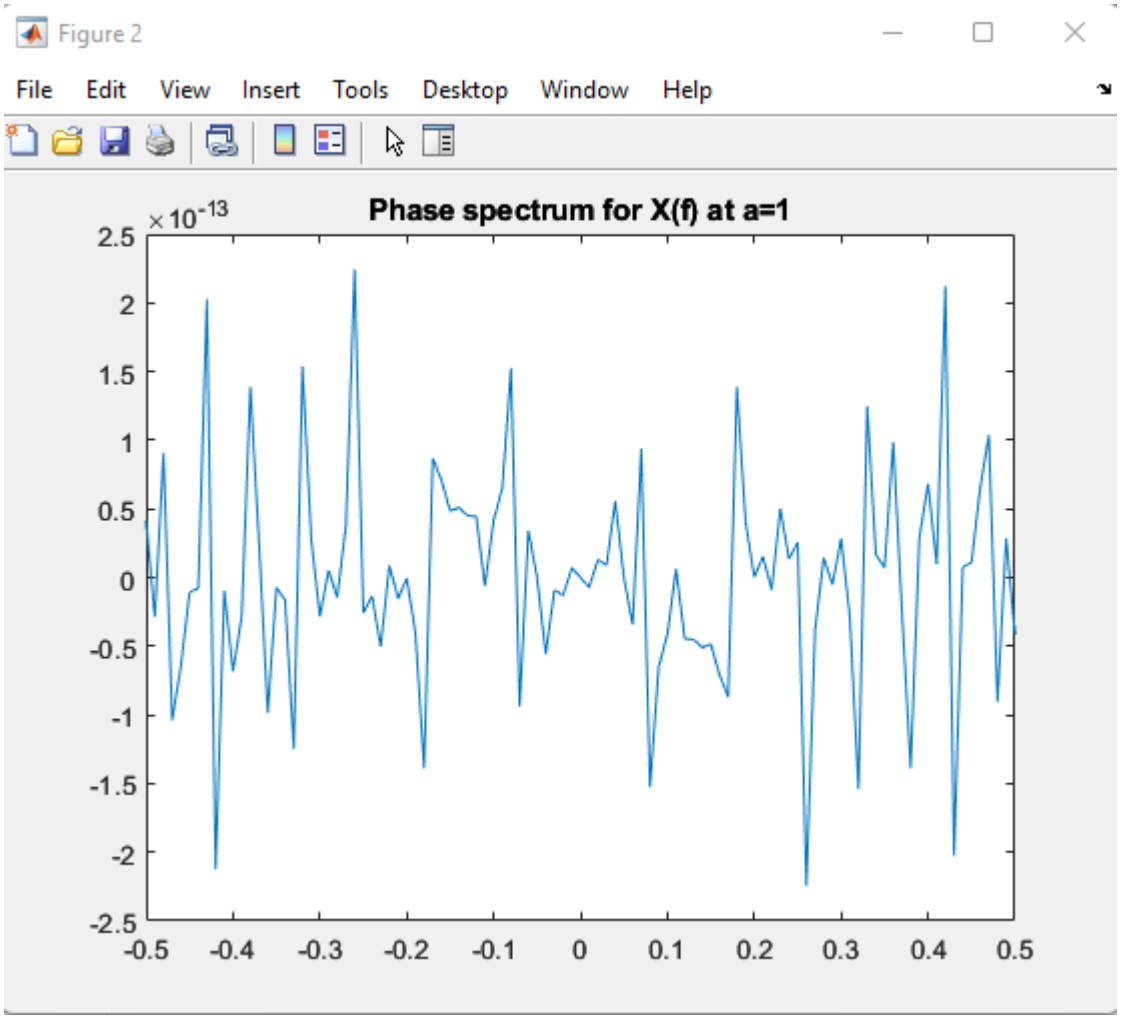
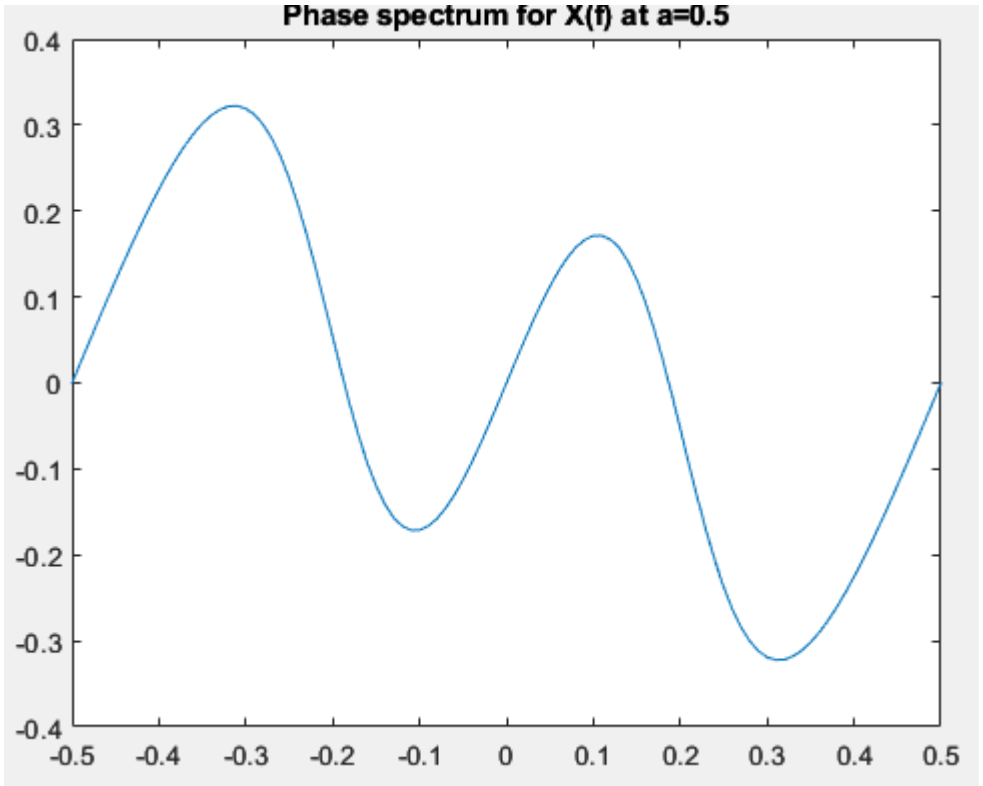
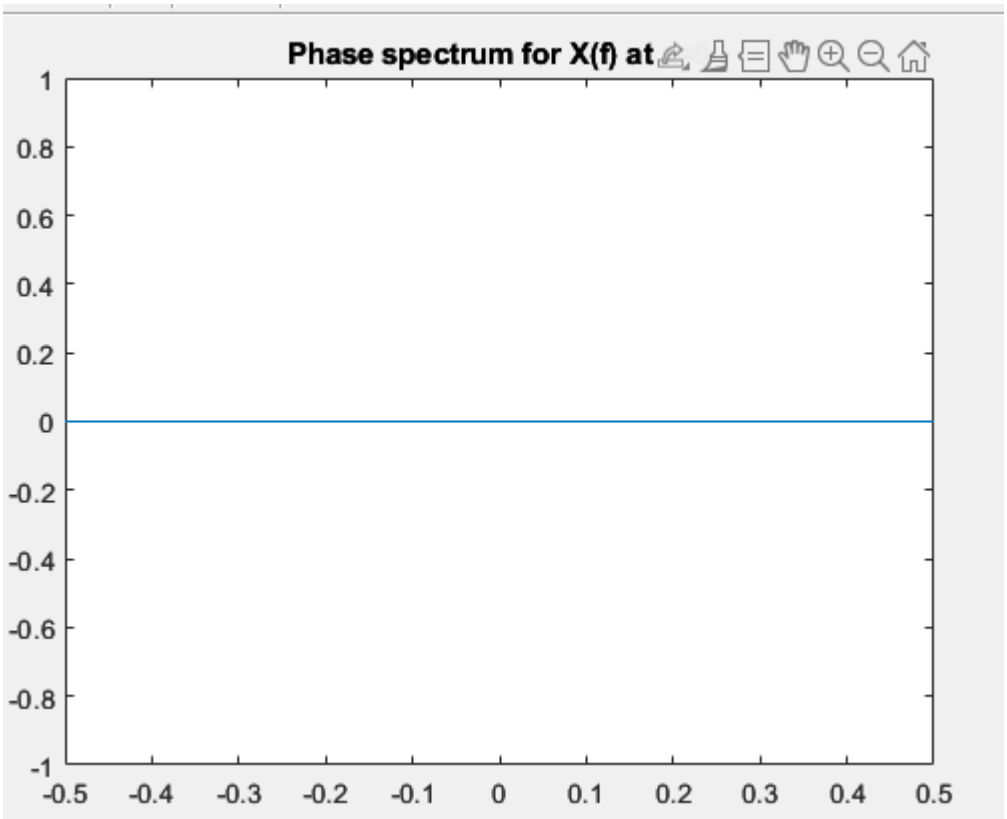


Figure 2
File Edit View Insert Tools Desktop Window Help
Phase spectrum for X(f) at a=1
×10^-13
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5


Phase spectrum for X(f) at a=0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5



3)

f0=0.2, a=0.9, phase angle is from 0 to pi

When **theta angle =0:**

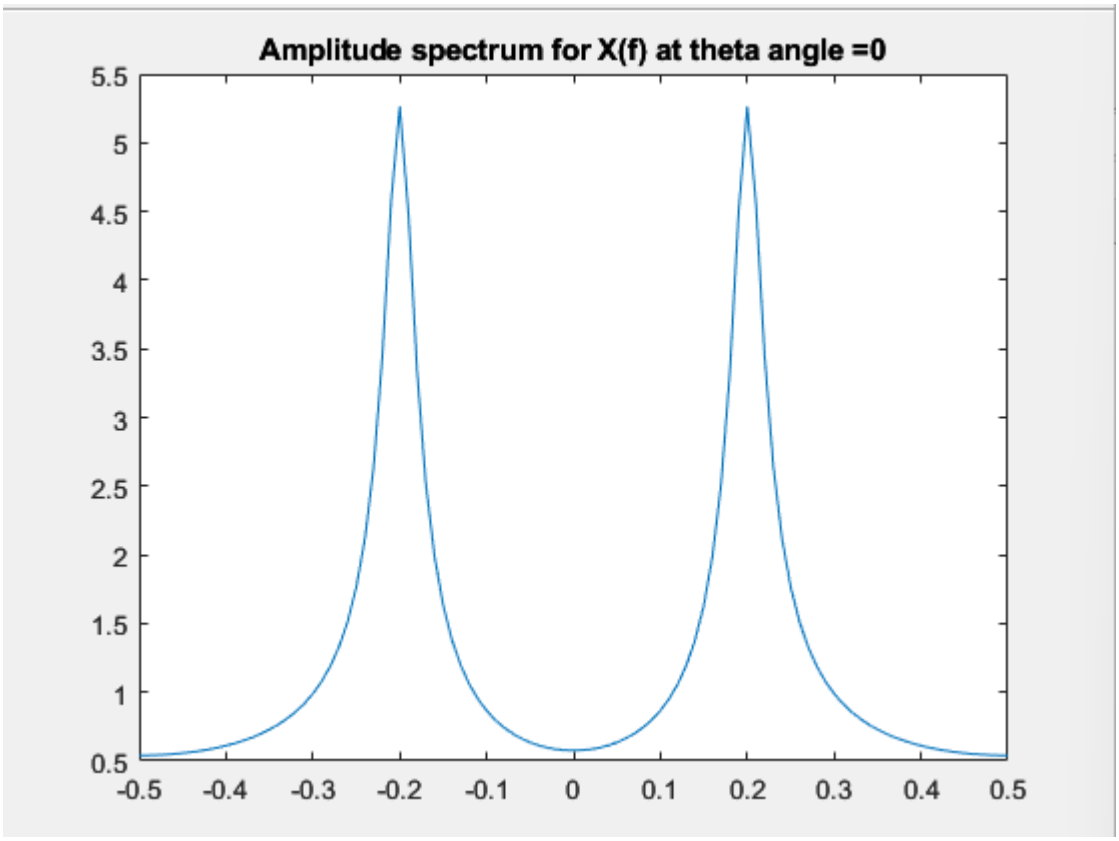
For the coding part

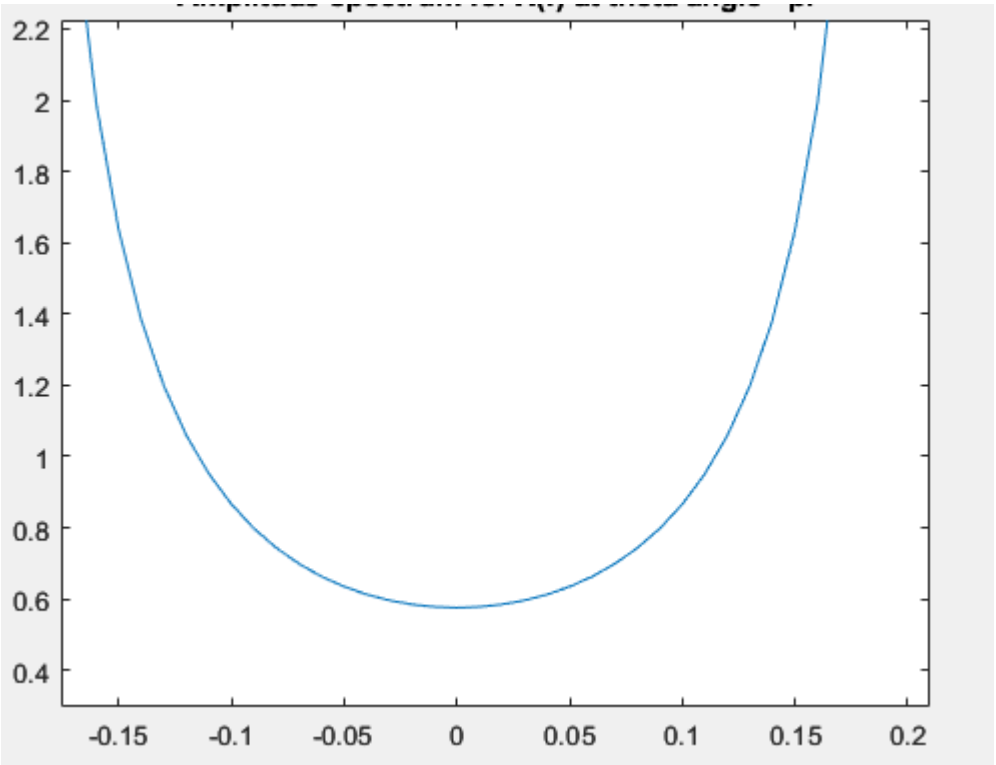
Editor - C:\Users\thong\Downloads\LAB3_PART3_EE110B.m

EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m | LAB3_PART

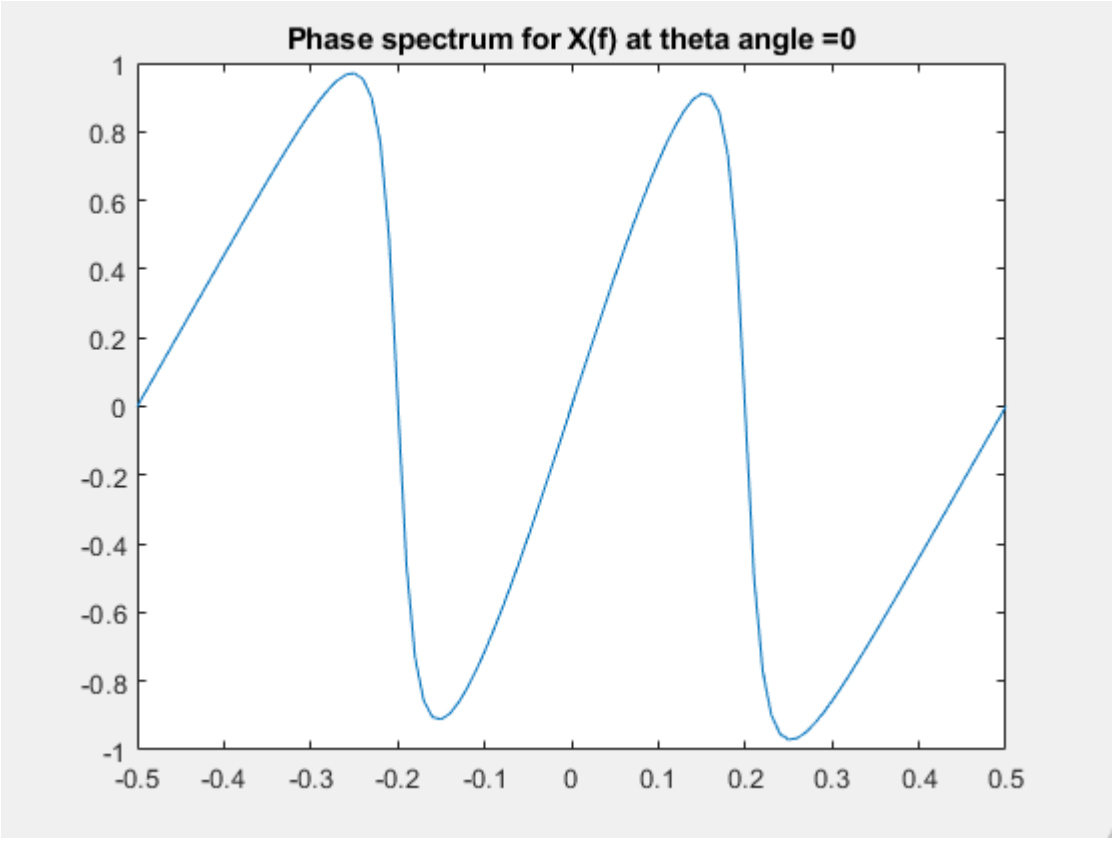
```
clear;;clc;close all;
n=0:200;
f0= 0.2;
a=0.9;
theta= 0;
x=a.^n.*cos(2*pi*f0*n);
z=zeros(101,1);
for k=-50:50
    z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
end
f = -0.5:0.01:0.5;
figure(1);
plot(f,abs(z));

title('Amplitude spectrum for X(f) at theta angle =0');


%angle
figure(2);
plot(f,angle(z));
title('Phase spectrum for X(f) at theta angle =0');

```

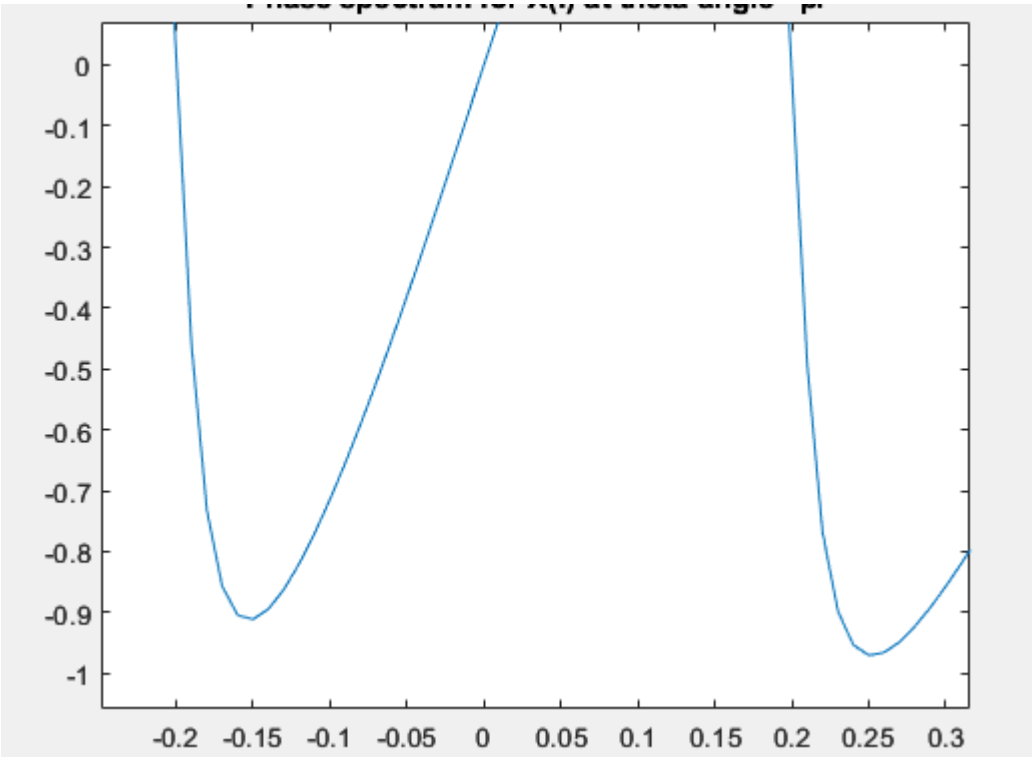
For the amplitude spectrum:

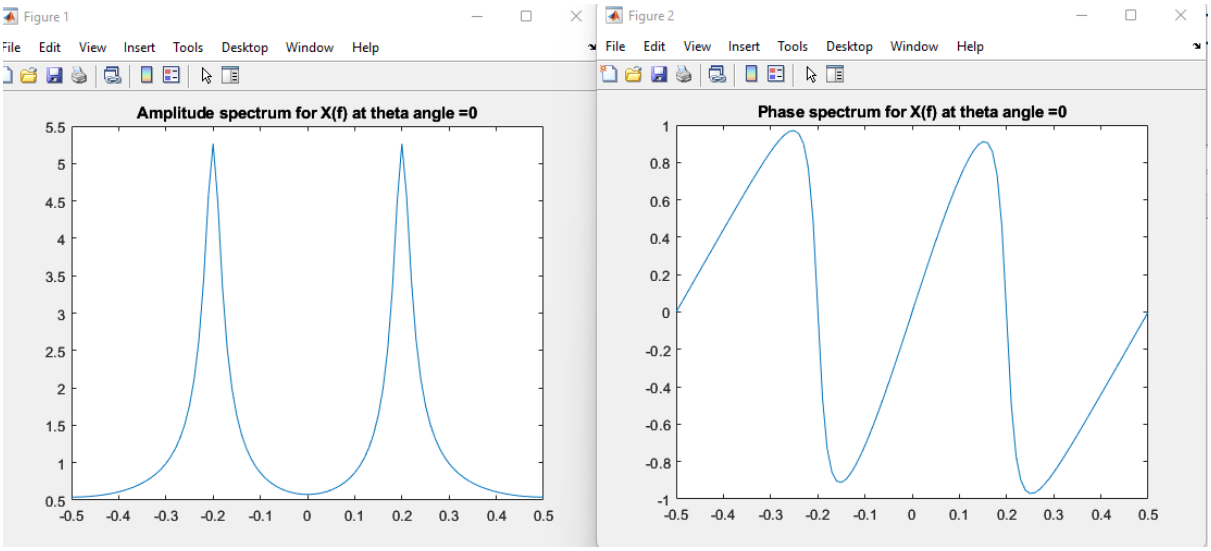




For the phase spectrum:







When **theta angle=pi/2:**

For the coding part:

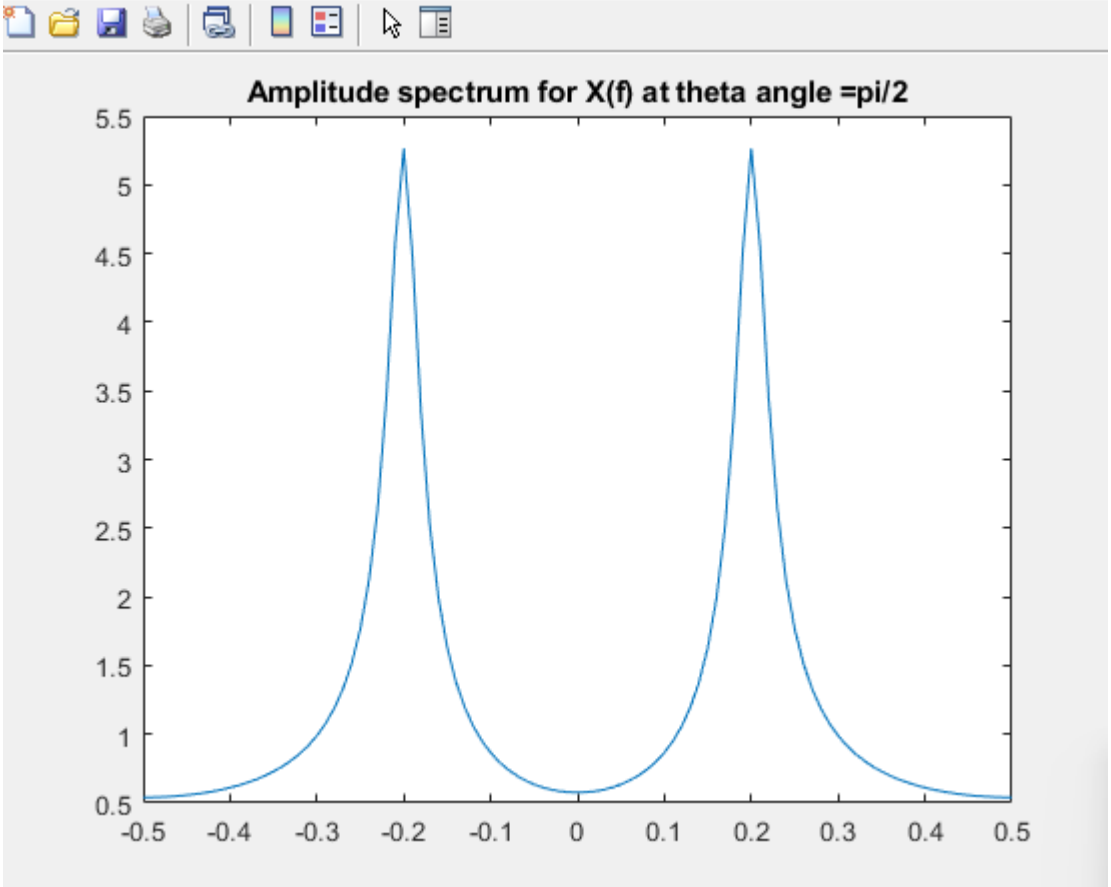
C: ▸ Users ▸ thong ▸ Downloads ▸

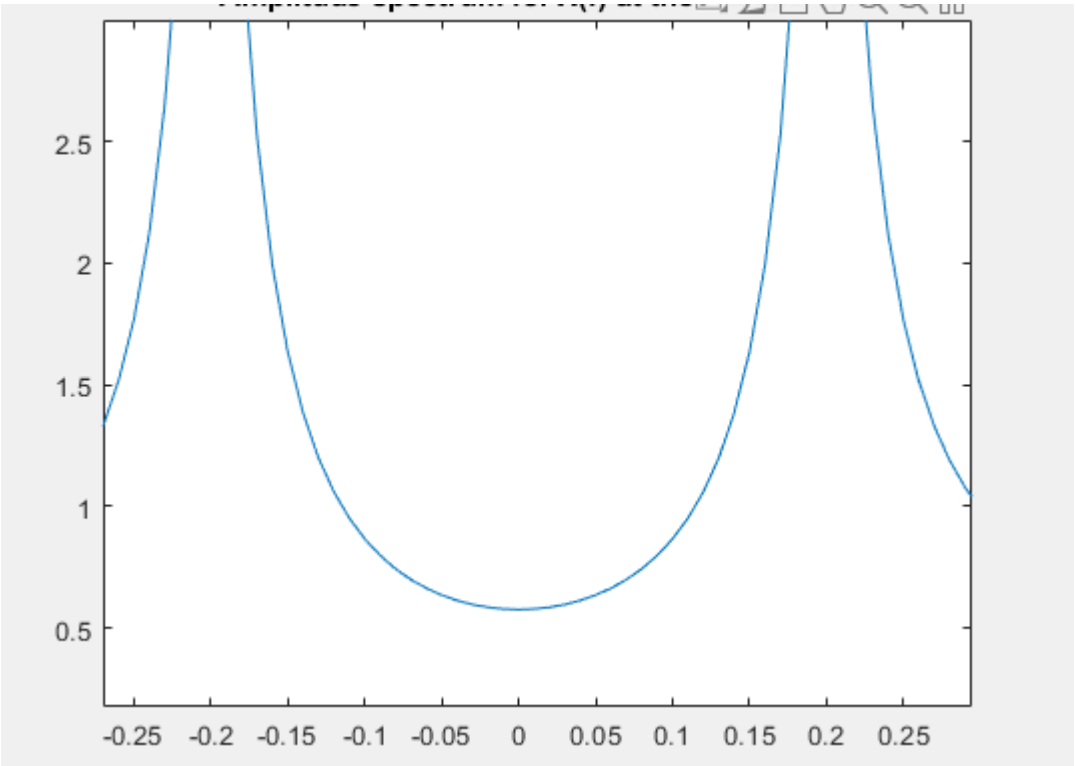
Editor - C:\Users\thong\Downloads\LAB3_PART3_EE110B.m

EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m | LAB3_PART2

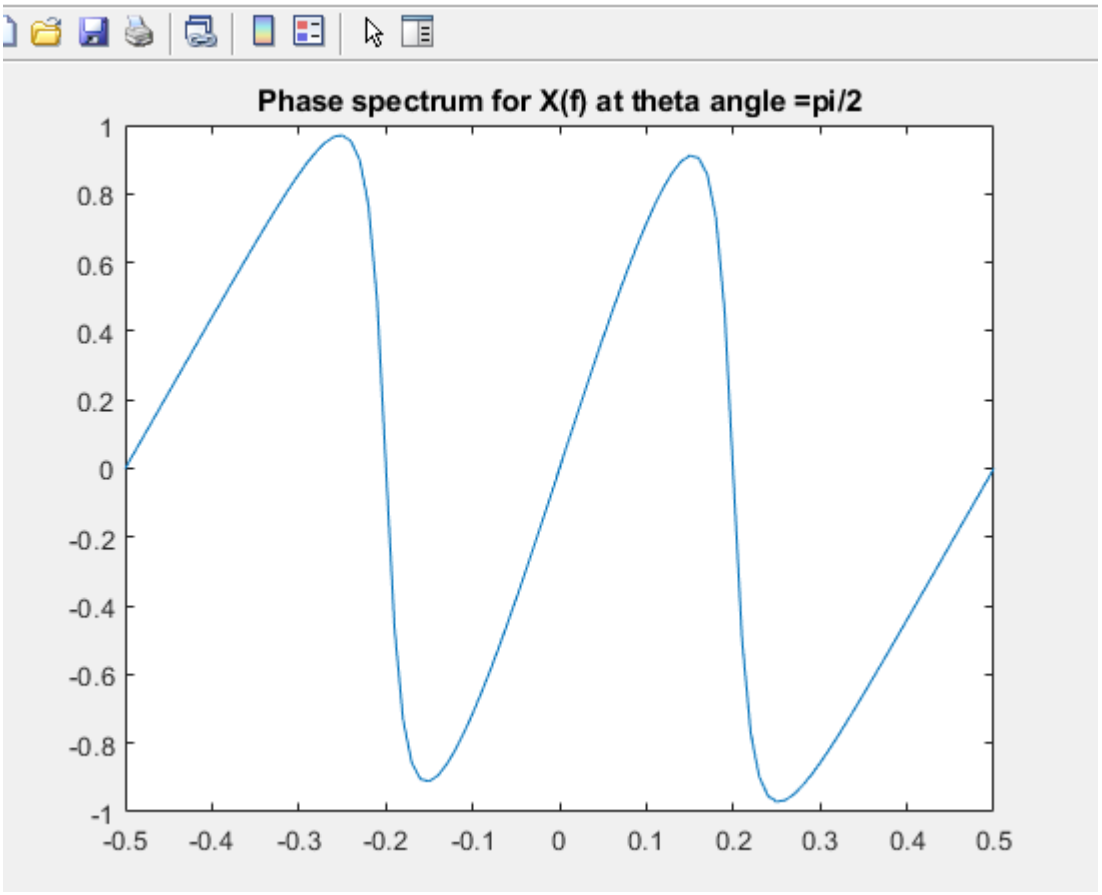
```
clear;;clc;close all;
n=0:200;
f0= 0.2;
a=0.9;
theta= pi/2;
x=a.^n.*cos(2*pi*f0*n);
z=zeros(101,1);
for k=-50:50
    z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
end
f = -0.5:0.01:0.5;
figure(1);
plot(f,abs(z));

title('Amplitude spectrum for X(f) at theta angle =pi/2');


%angle
figure(2);
plot(f,angle(z));
title('Phase spectrum for X(f) at theta angle =pi/2');


```

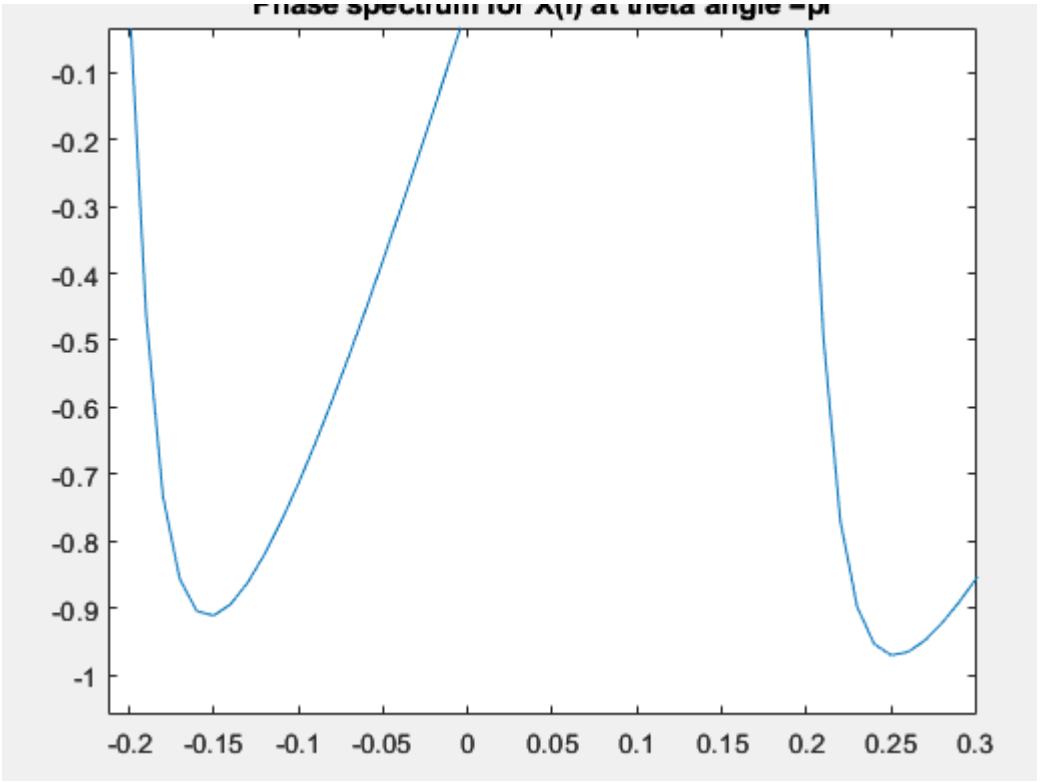
For the amplitude spectrum:

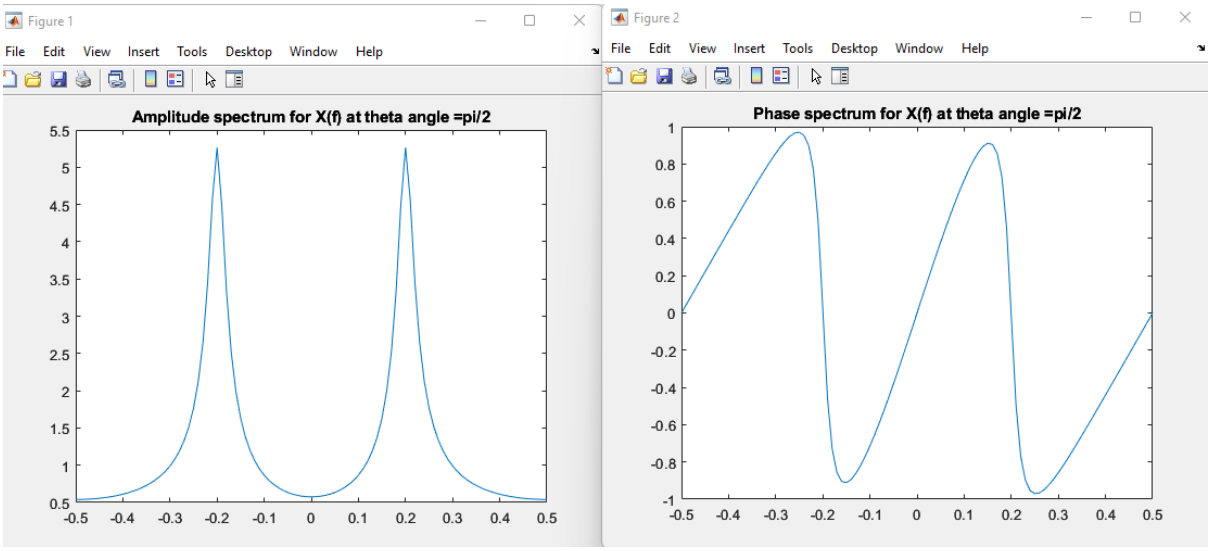




For the phase spectrum:


Phase spectrum for X(f) at theta angle =pi/2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5


-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3



When **theta angle = pi:**

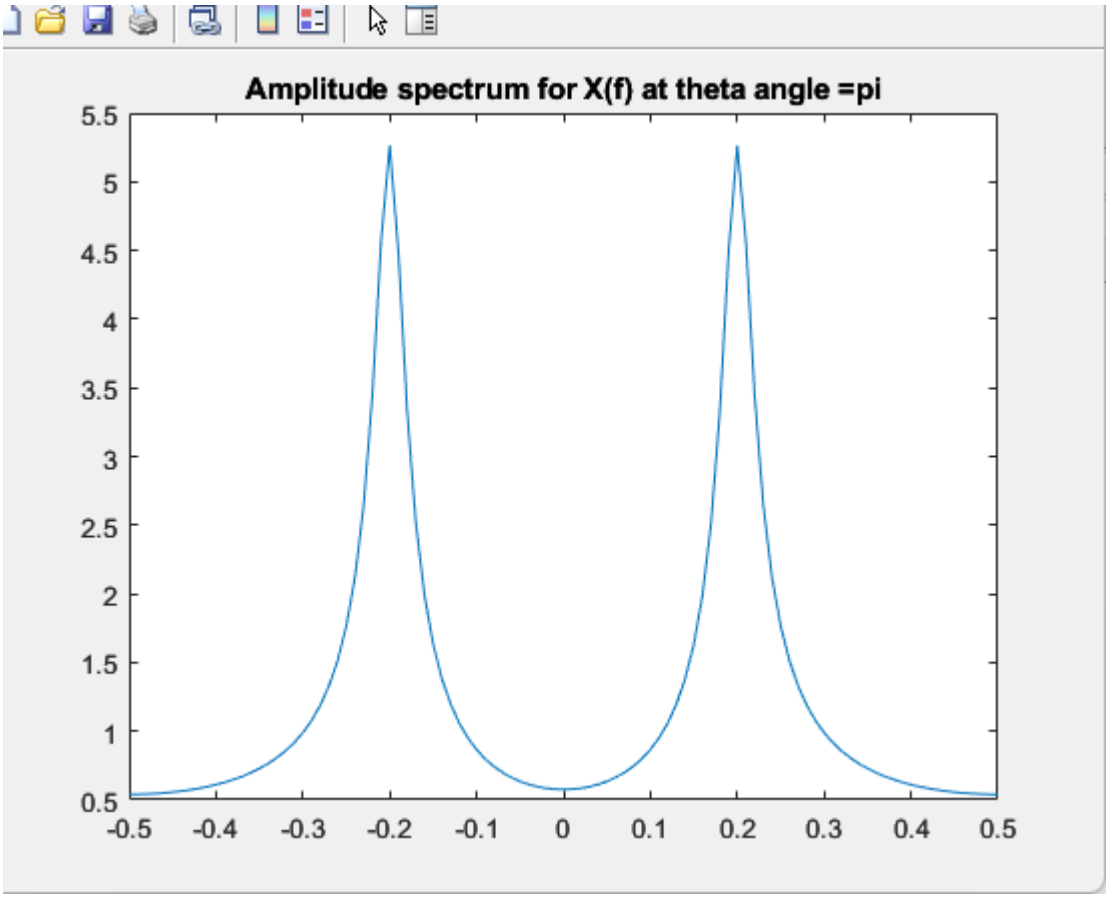
For the coding part:

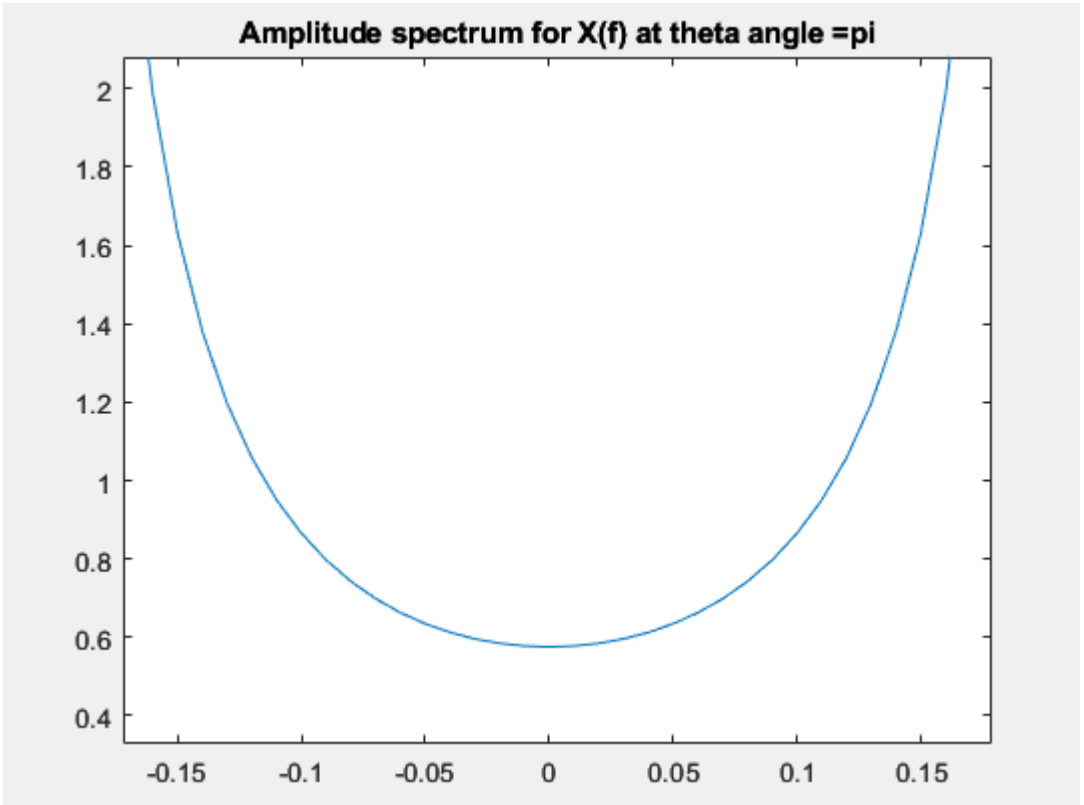
Edito - C:\Users\thong\Downloads\LAB3_PART3_EE110B.m

EE110B_lab2_part2a.m | lab2_part1.m | hw3.m | lab3_ee110b.m | LAB3_PART2_

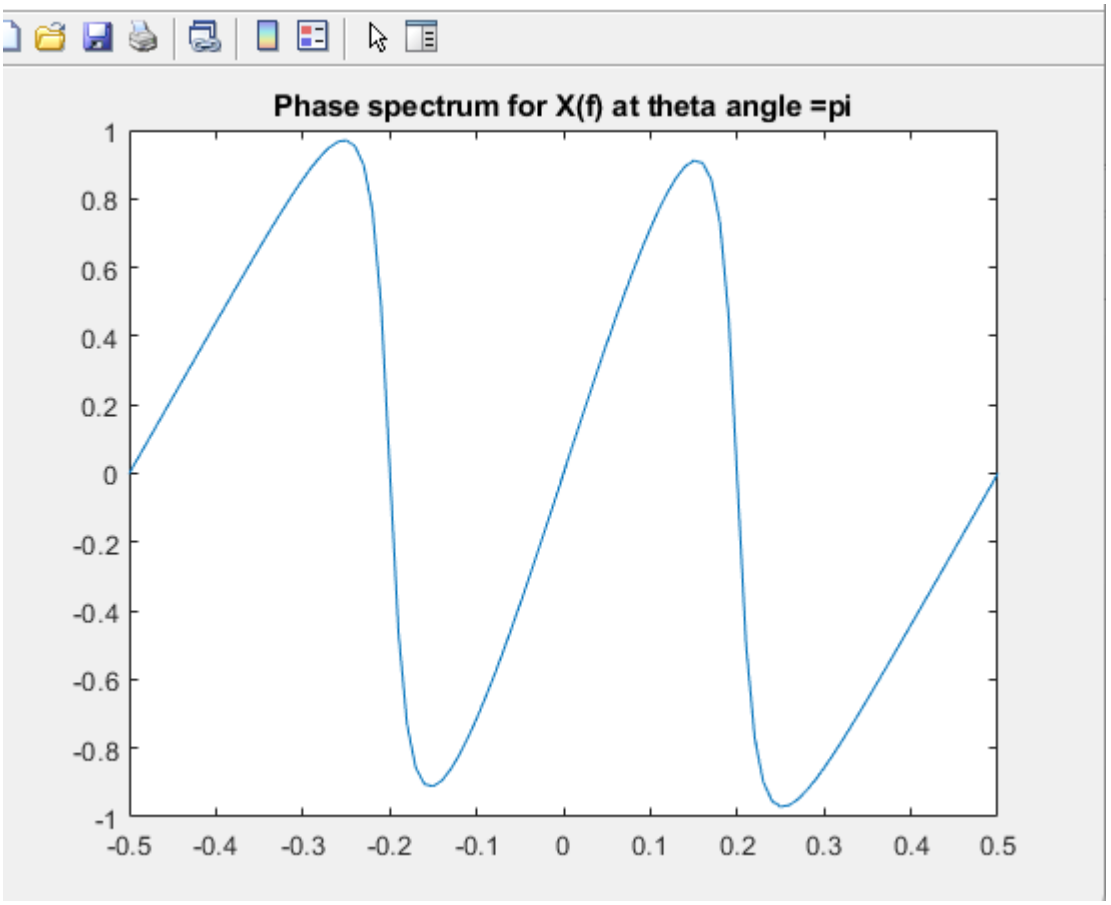
```
clear;;clc;close all;
n=0:200;
f0= 0.2;
a=0.9;
theta= pi;
x=a.^n.*cos(2*pi*f0*n);
z=zeros(101,1);
for k=-50:50
    z(k+51) = sum(x.*exp(-1j*2*pi*(k/100).*n));
end
f = -0.5:0.01:0.5;
figure(1);
plot(f,abs(z));

title('Amplitude spectrum for X(f) at theta angle =pi');


%angle
figure(2);
plot(f,angle(z));
title('Phase spectrum for X(f) at theta angle =pi');


```

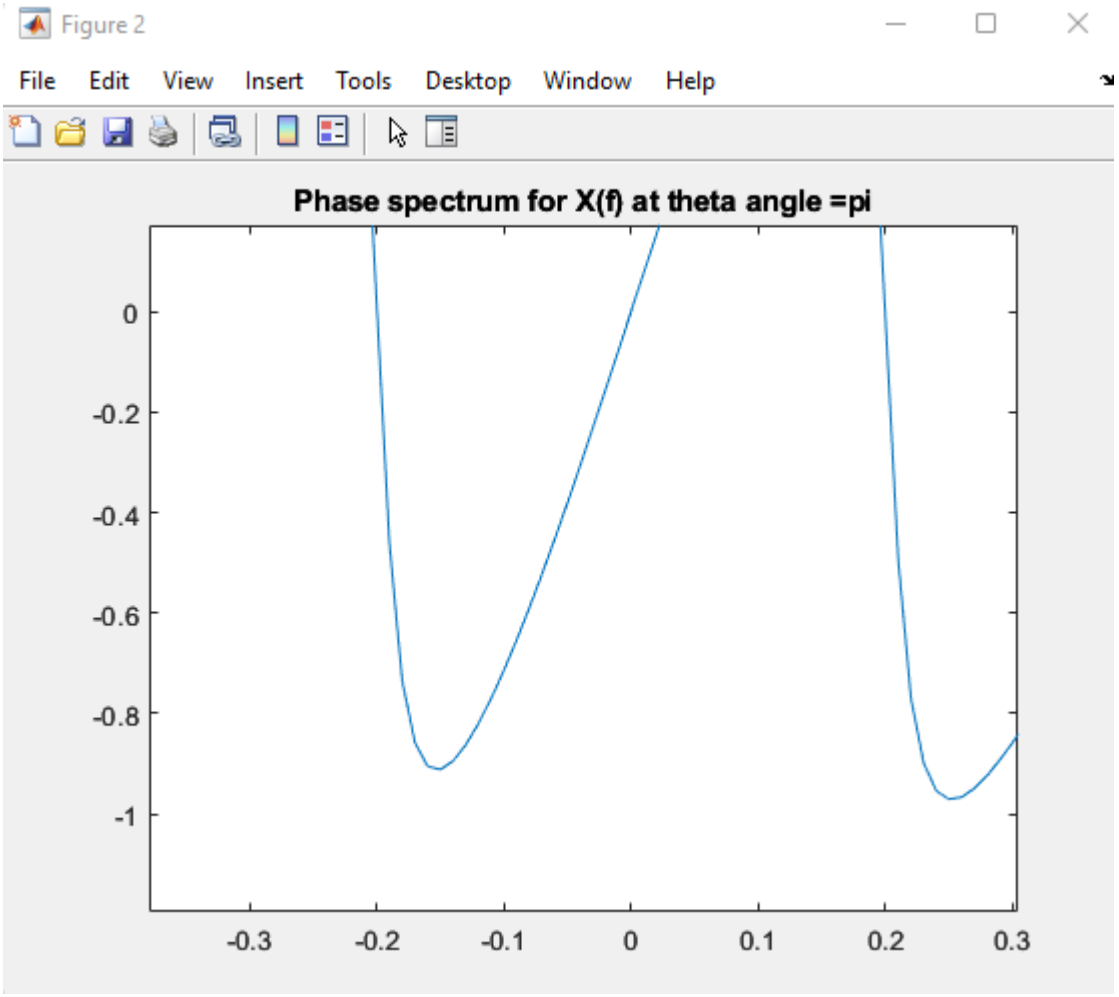
For the amplitude spectrum:

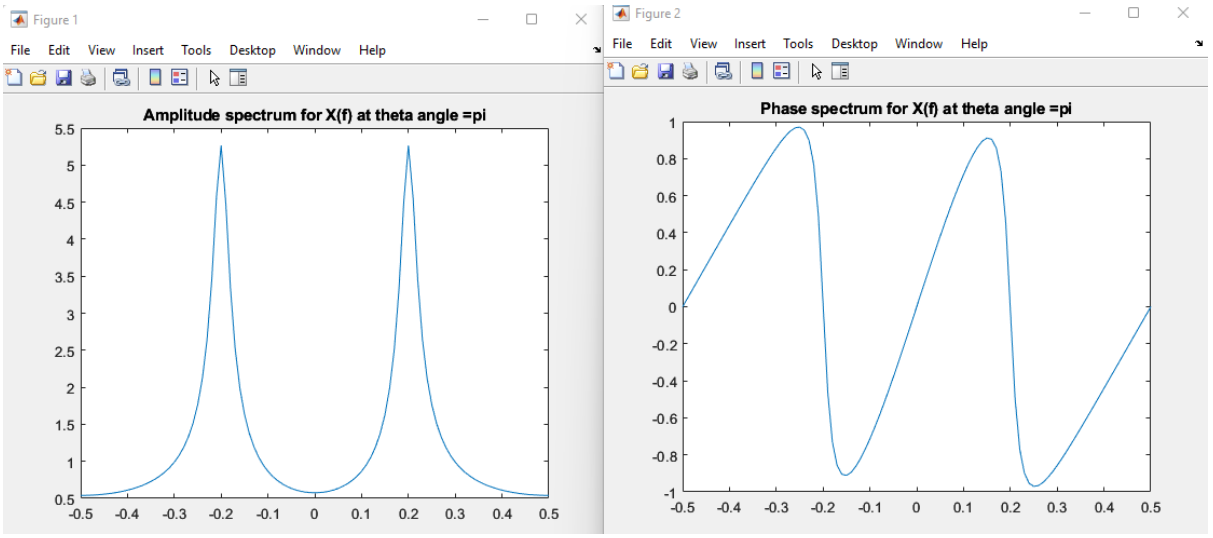

Amplitude spectrum for X(f) at theta angle =pi
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5


Amplitude spectrum for X(f) at theta angle =pi
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
-0.15
-0.1
-0.05
0
0.05
0.1
0.15

For the phase spectrum:







The effect of these parameters when theta angle changes from 0 to pi is

For the amplitude spectrum, the amplitude of the graph **stays the same** no matter what the theta angle changes from 0 to pi.

For the phase spectrum, the phase angle also **stays the same** throughout the graph no matter what theta angle changes from 0 to pi.