classmate
Date
Page 13

Experiment - 5

18B160043
Allen Ben Philipose
ECE1018 - Lab
L21 + L22

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1. Fourier series of a square wave

Period = 2ms

Peak-to-peak value = 2V

Average value = 0V

$$x(t) = 4/\pi \sum_{n=0}^{\infty} 1/(2n+1) \sin((2n+1) 2\pi f_0 t)$$

2. Fourier series of a sawtooth wave

$$x(t) = 2/\pi \sum_{n=01}^{\infty} (-1)^{n+1} (\sin n\omega t / n)$$

3. Fourier series of a triangular wave

$$x(t) = 8/\pi^2 \sum_{n=0}^{\infty} (-1)^n [\sin((2n+1)\omega t)/(2n+1)^2]$$

4. Find the approximate CTFS harmonic function of a periodic signal $x(t)$ where

$$x(t) = \sqrt{1-t^2}, \quad -1 \leq t \leq 1$$

Should not use built-in functions

Scanned by CamScanner

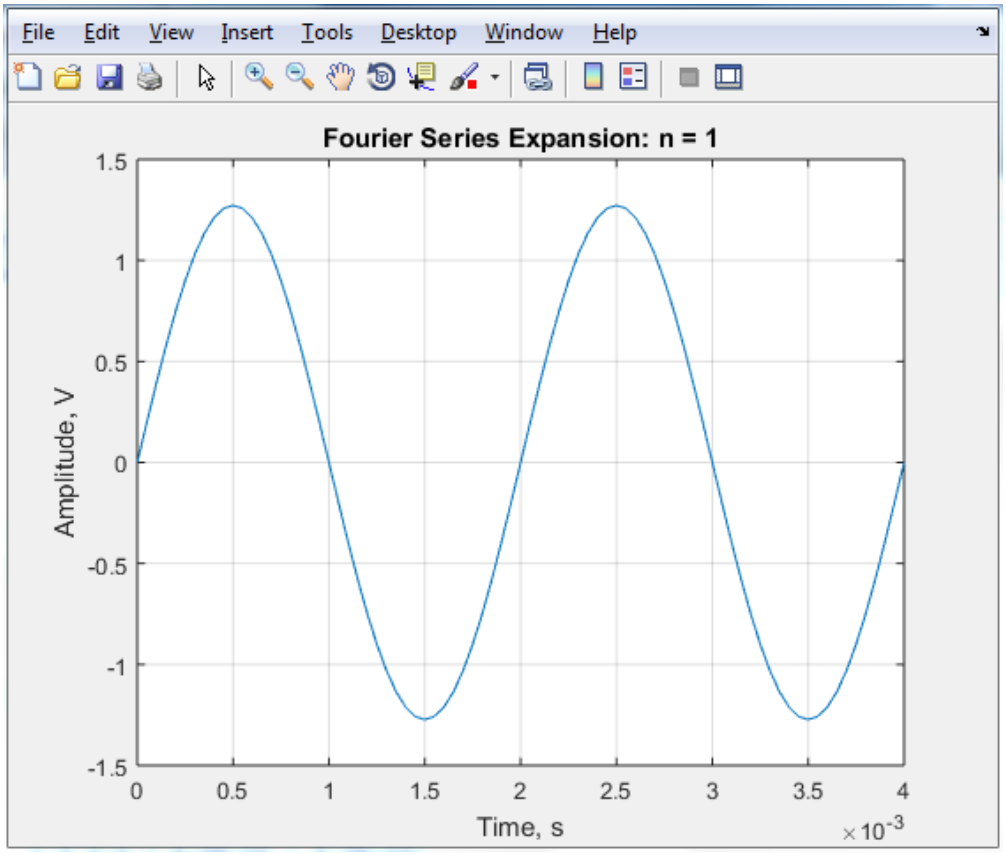
Experiment – 5

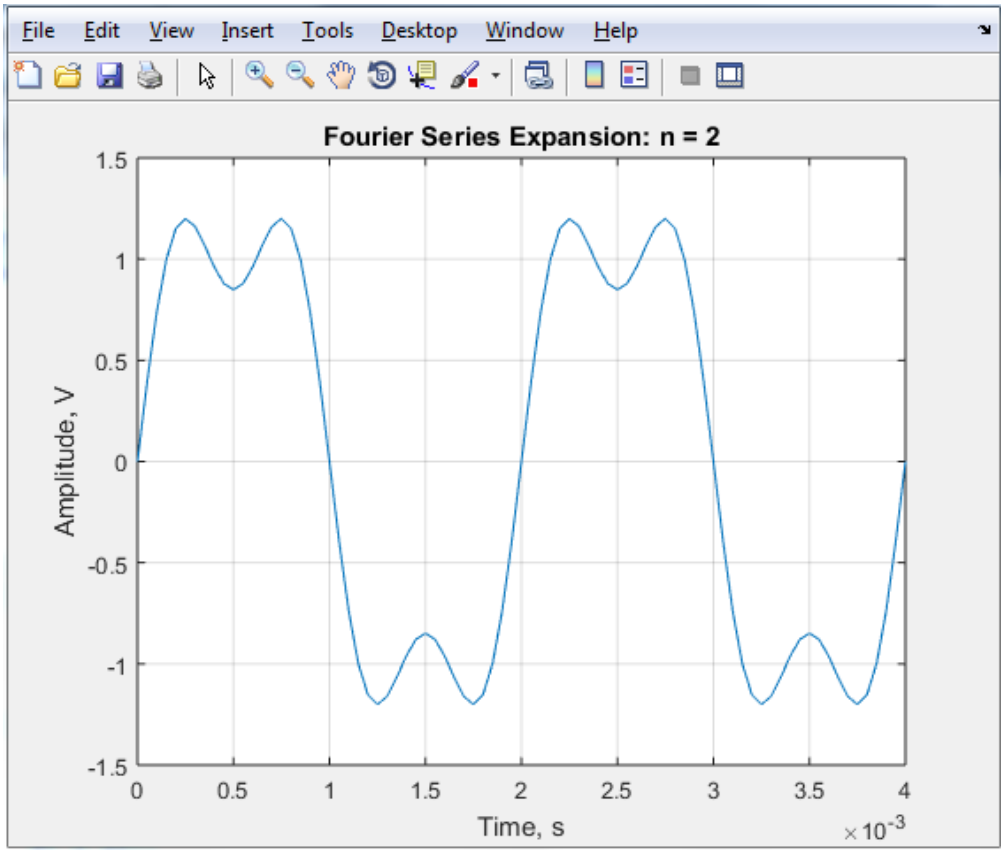
1.

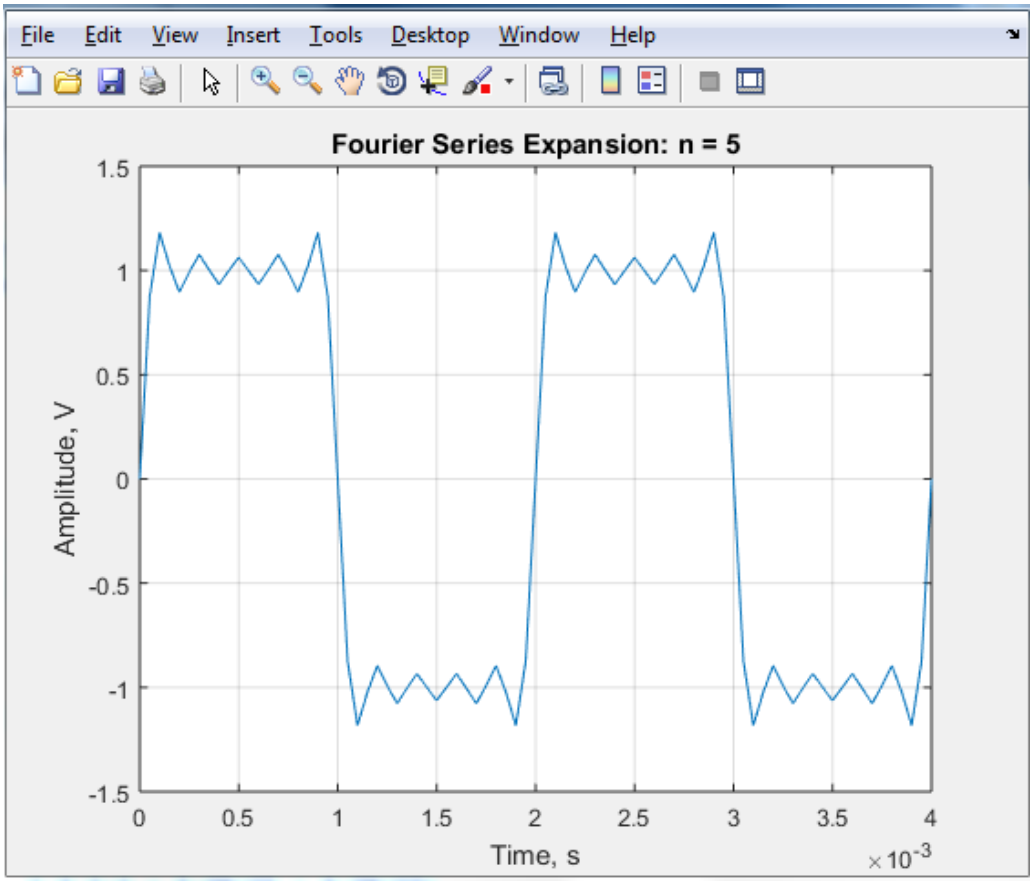
Editor - C:\Users\batch1\Desktop\Allen\T14.m

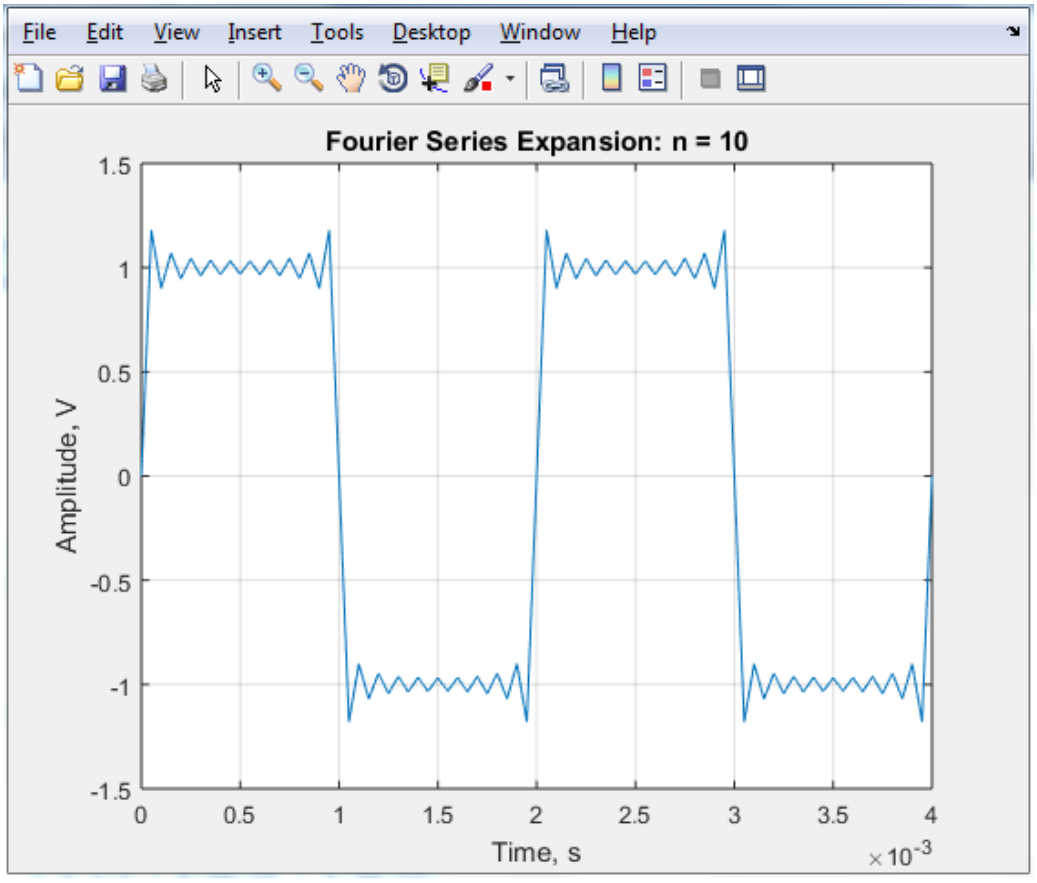
T14.m | T15.m | T16.m

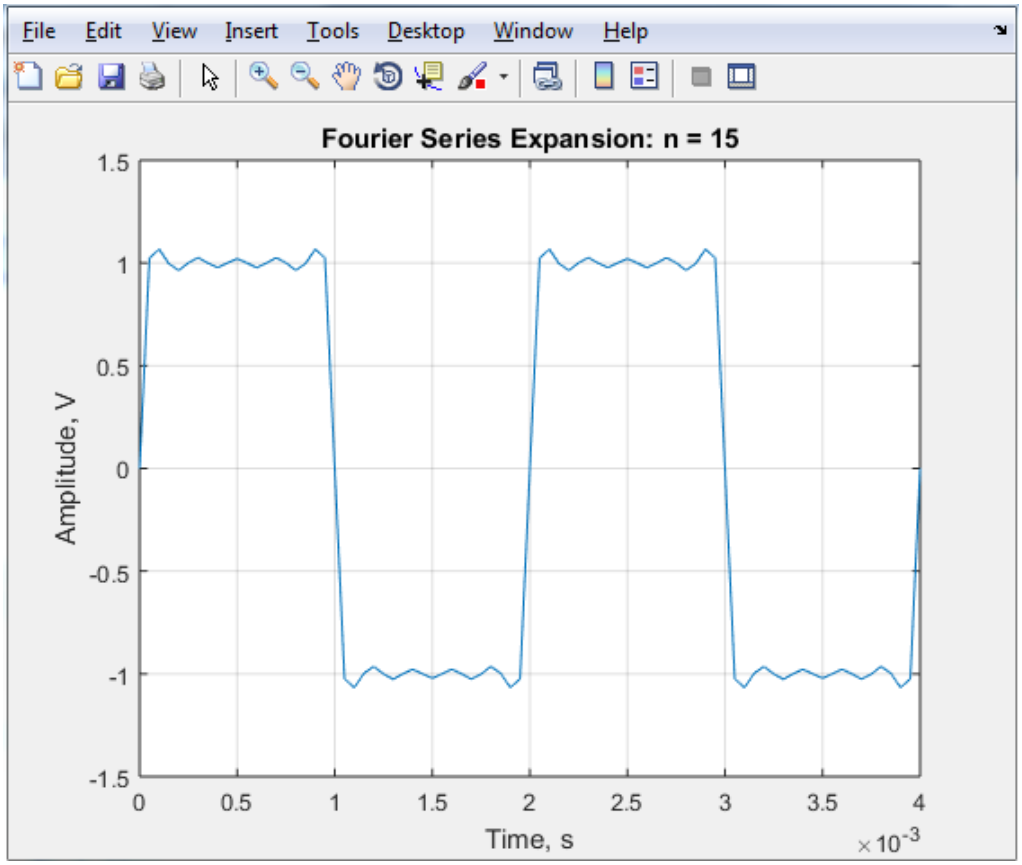
```
% 18BIS0043
clc
clear all
f = 500;
C = 4/pi;
dt = 5.0e-05;
totalpts = (4.0e-03/dt)+1

for n = 1:500
    for m = 1:totalpts
        s(n,m) = (4/pi)*(1/(2*n-1))*sin((2*n-1)*2*pi*f*dt*(m-1));
    end
end
for m = 1:totalpts
    a1 = s(:,m);
    a2(m) = sum(a1);
end
f1 = a2';
t = 0.0 : 5.0e-05 : 4.0e-03;

plot(t,f1)
grid on
xlabel('Time, s')
ylabel('Amplitude, V')
title('Fourier Series Expansion')
```

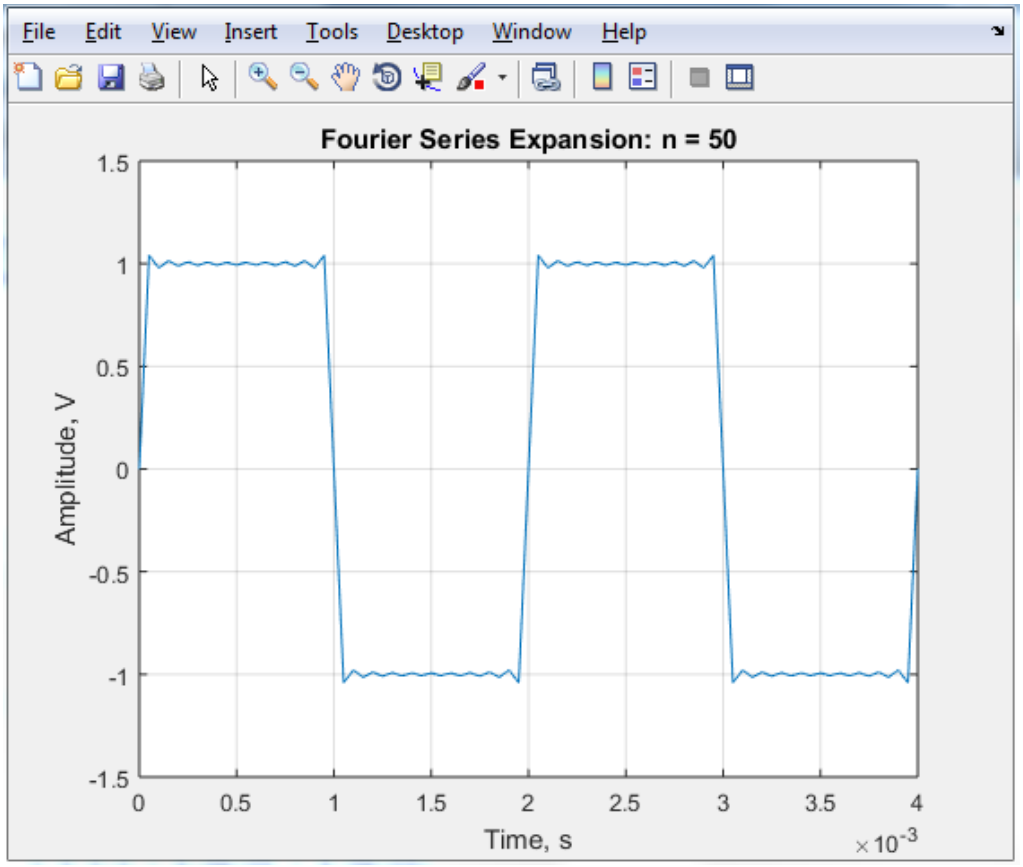

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 1
Amplitude, V
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4
Time, s
×10-3

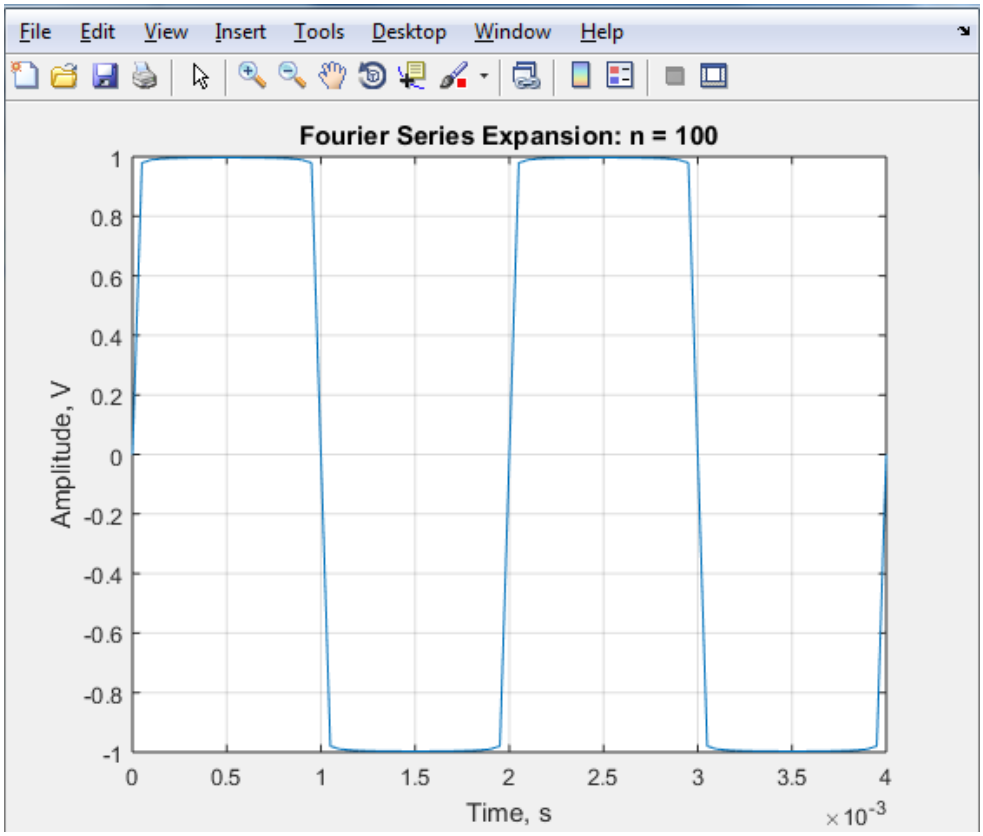

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 2
Amplitude, V
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4
Time, s
×10-3

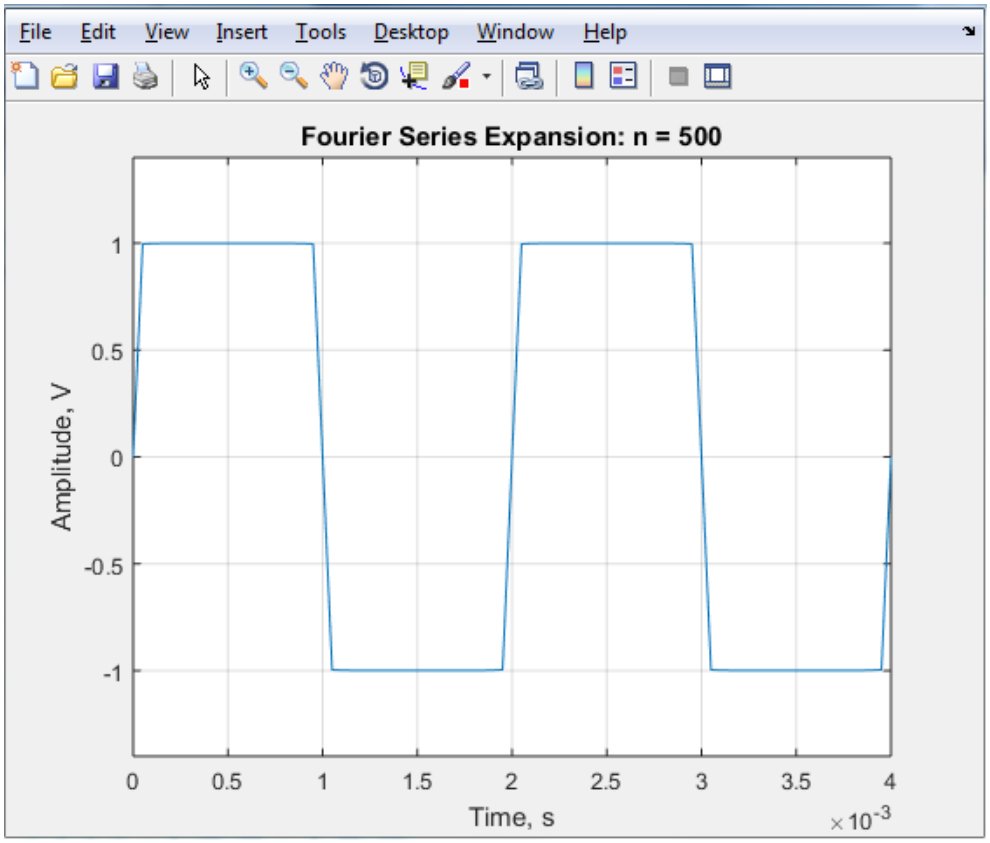

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 5
Amplitude, V
Time, s
×10^-3
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 10
Amplitude, V
Time, s
×10^-3
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 15
Amplitude, V
Time, s
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 50
Amplitude, V
Time, s
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 100
Amplitude, V
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
3
3.5
4
Time, s
×10-3

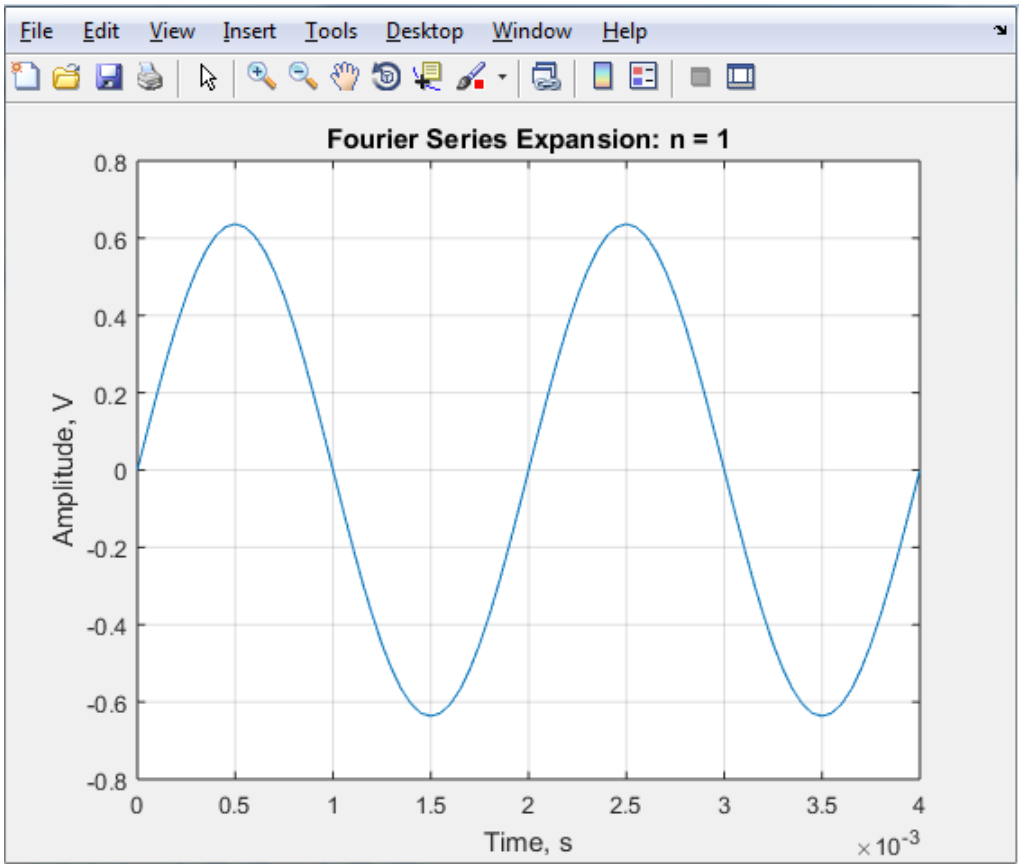

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 500
Amplitude, V
1
0.5
0
-0.5
-1
0
0.5
1
1.5
2
2.5
3
3.5
4
Time, s
×10-3

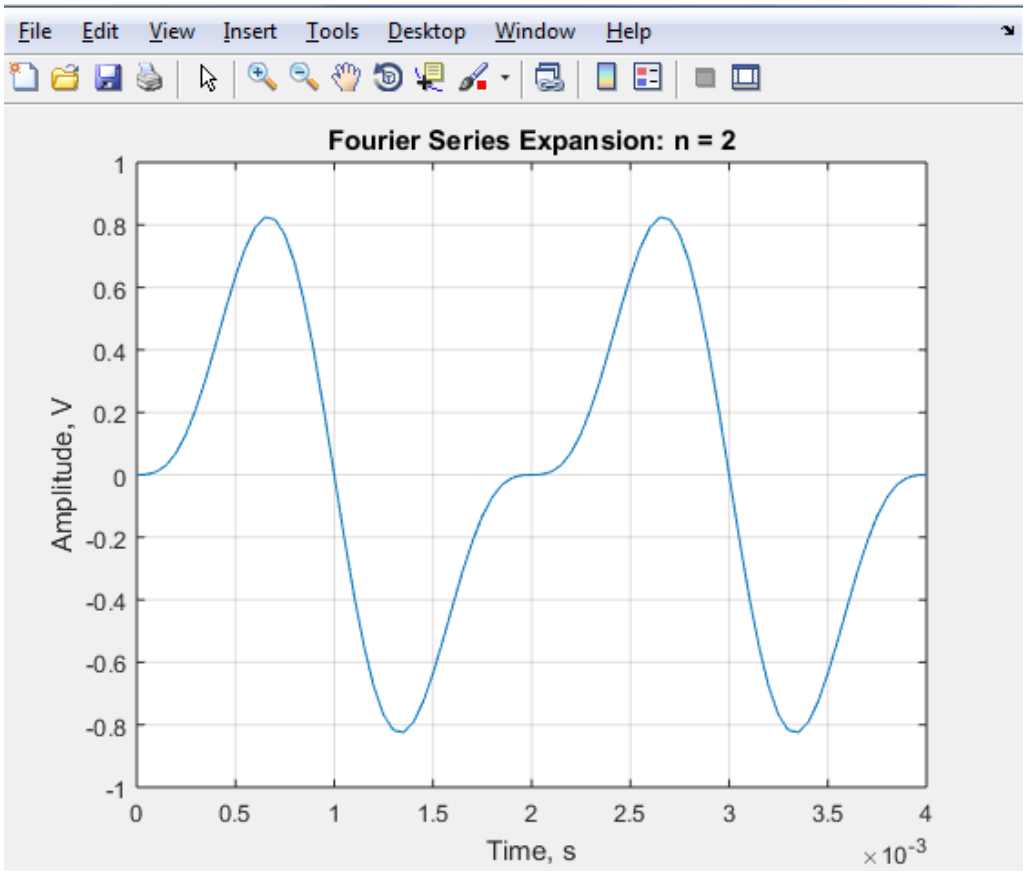
2.

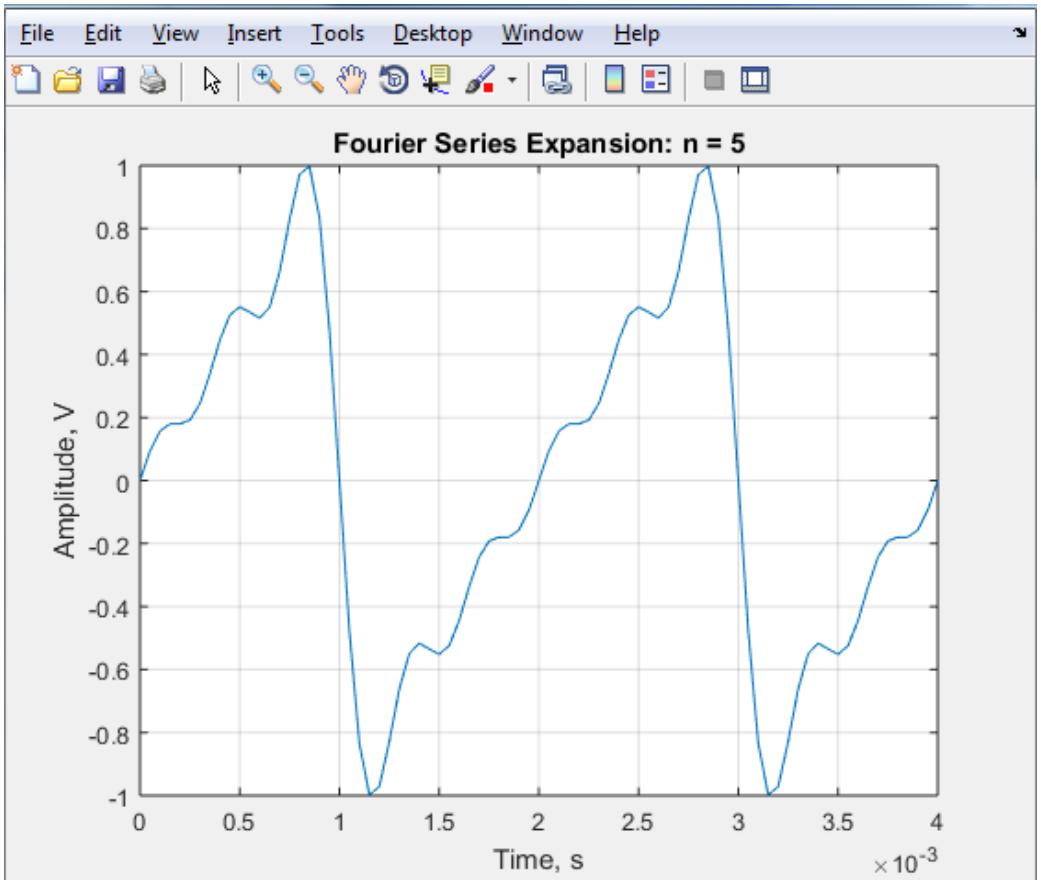
Editor - C:\Users\batch1\Desktop\Allen\T15.m

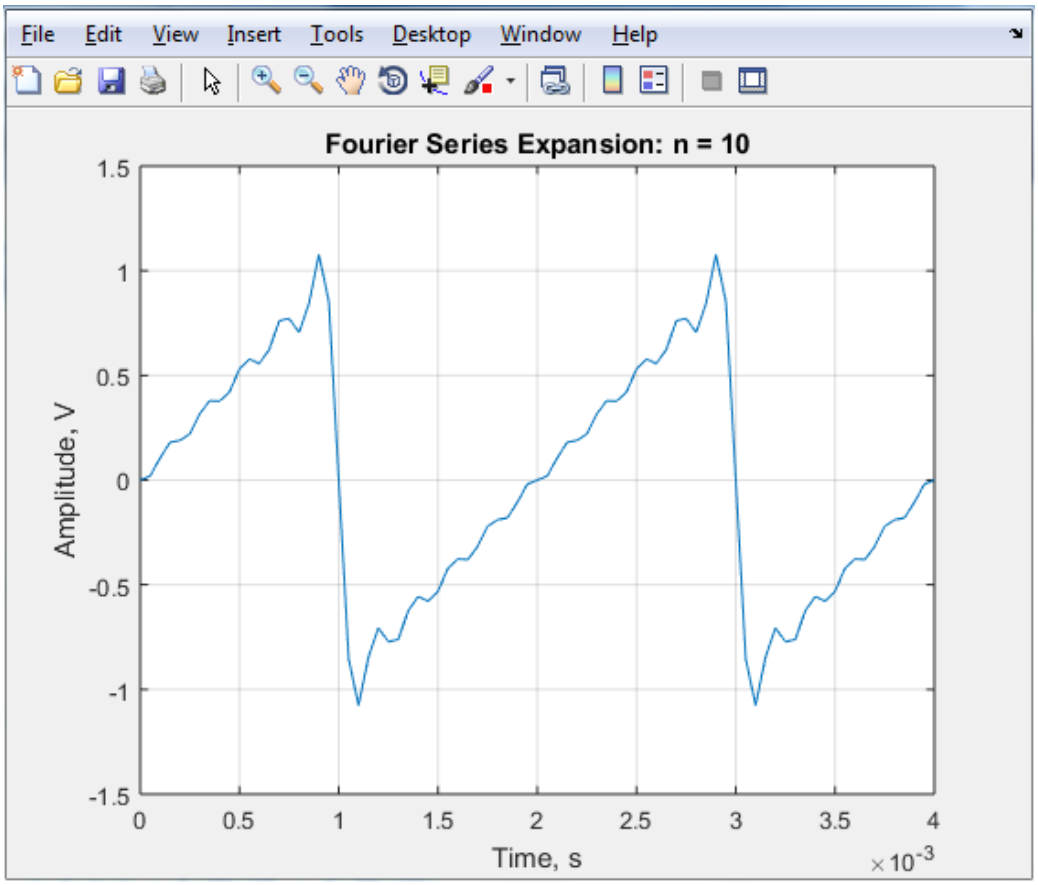
T14.m | T15.m | T16.m

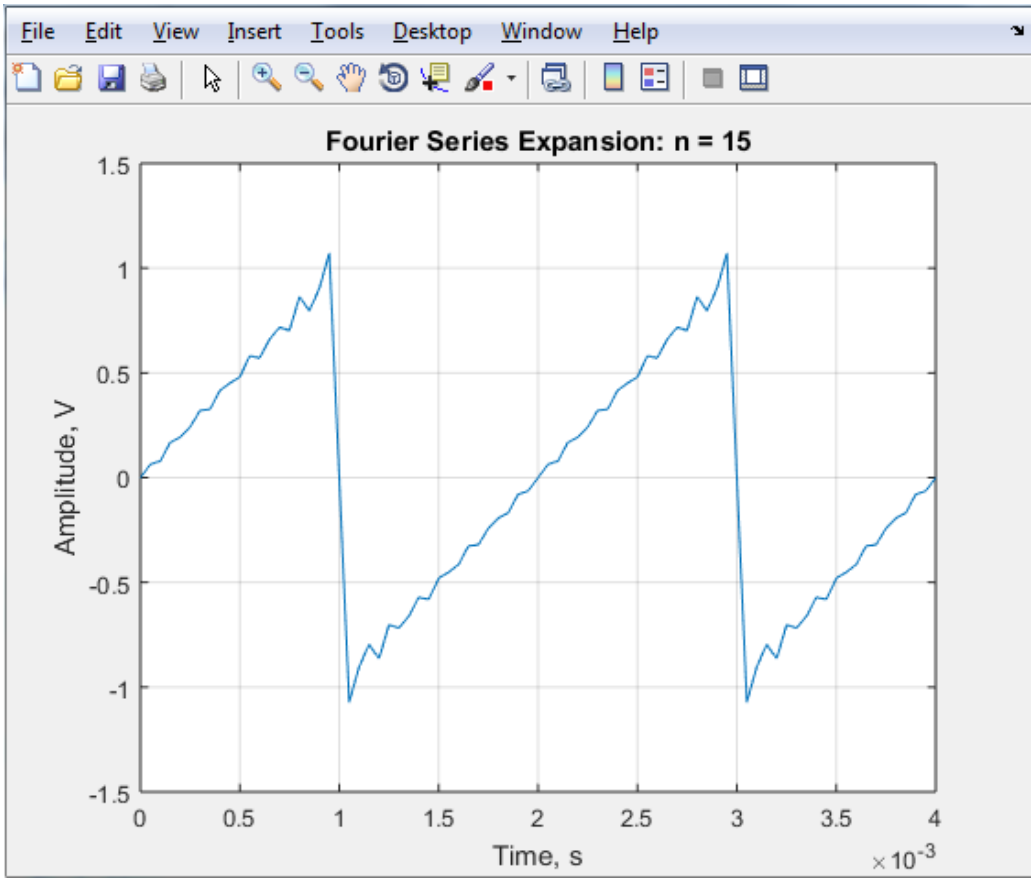
```
% 18BIS0043
clc
clear all
f = 500;
C = 4/pi;
dt = 5.0e-05;
totalpts = (4.0e-03/dt)+1

for n = 1:500
    for m = 1:totalpts
        s(n,m) = ((2/pi)*((-1).^(n+1))*sin(n*2*pi*f*dt*(m-1))/n);
    end
end
for m = 1:totalpts
    a1 = s(:,m);
    a2(m) = sum(a1);
end
f1 = a2';
t = 0.0 : 5.0e-05 : 4.0e-03;

plot(t,f1)
grid on
xlabel('Time, s')
ylabel('Amplitude, V')
title('Fourier Series Expansion')
```

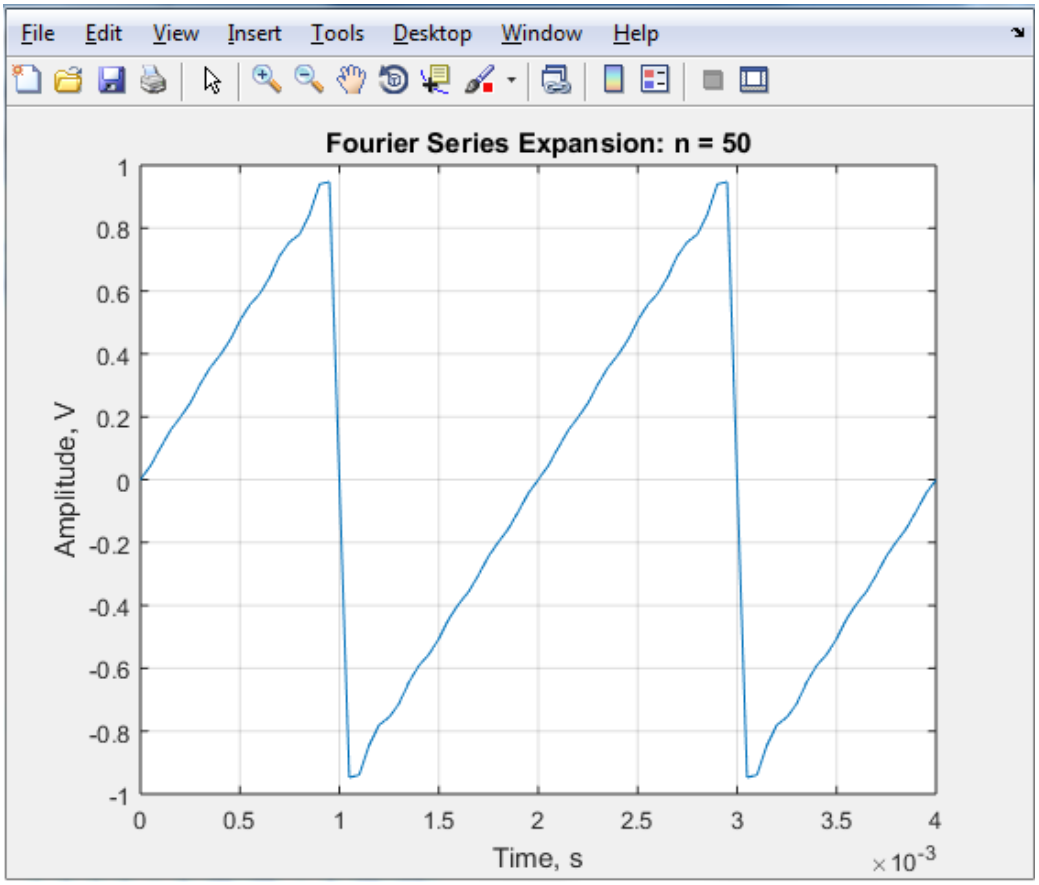

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 1
Amplitude, V
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0 0.5 1 1.5 2 2.5 3 3.5 4
Time, s
×10-3

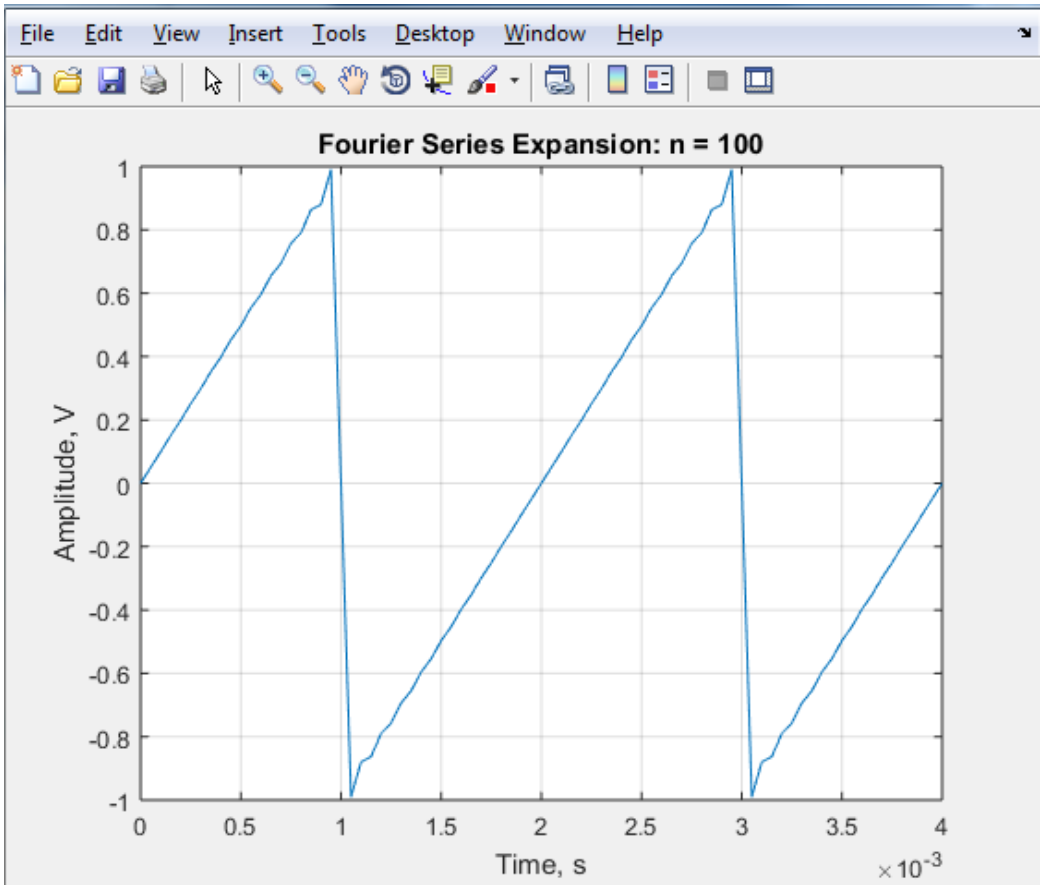

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 2
Amplitude, V
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0 0.5 1 1.5 2 2.5 3 3.5 4
Time, s
×10-3

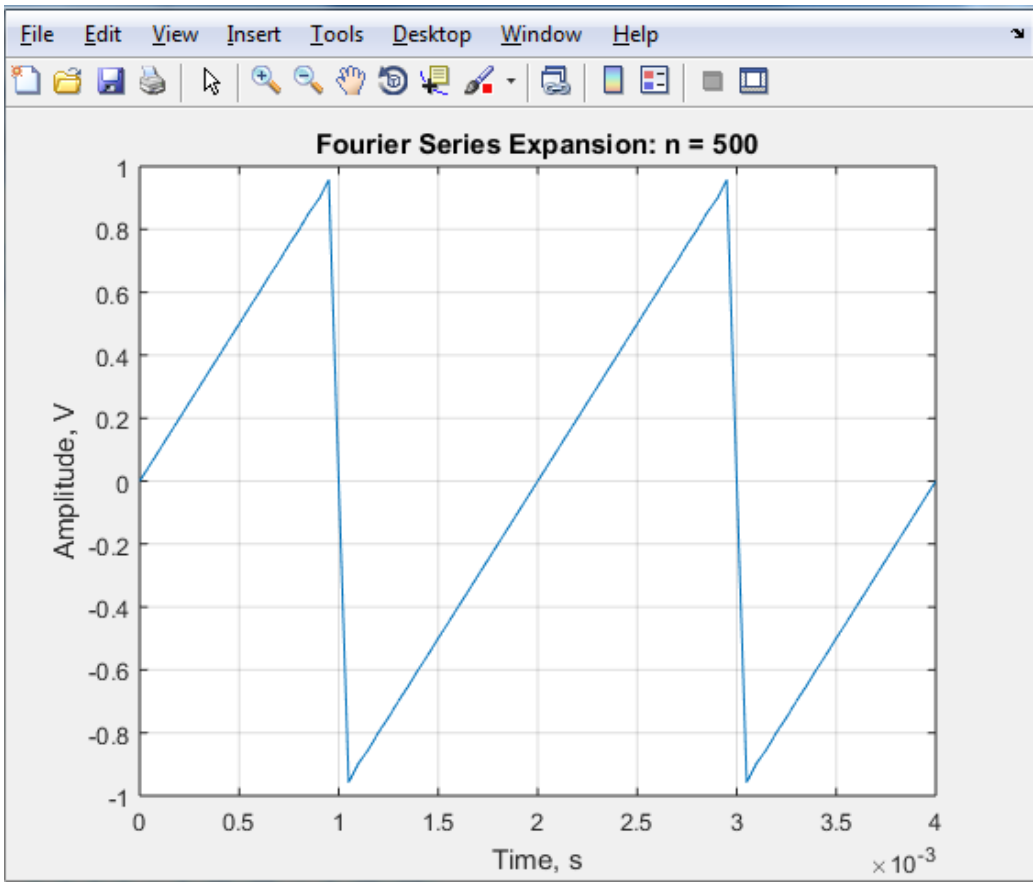

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 5
Amplitude, V
Time, s
×10^-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 10
Amplitude, V
Time, s
×10^-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 15
Amplitude, V
Time, s
1.5
1
0.5
0
-0.5
-1
-1.5
0 0.5 1 1.5 2 2.5 3 3.5 4
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 50
Amplitude, V
Time, s
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0 0.5 1 1.5 2 2.5 3 3.5 4
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 100
Amplitude, V
Time, s
×10^-3

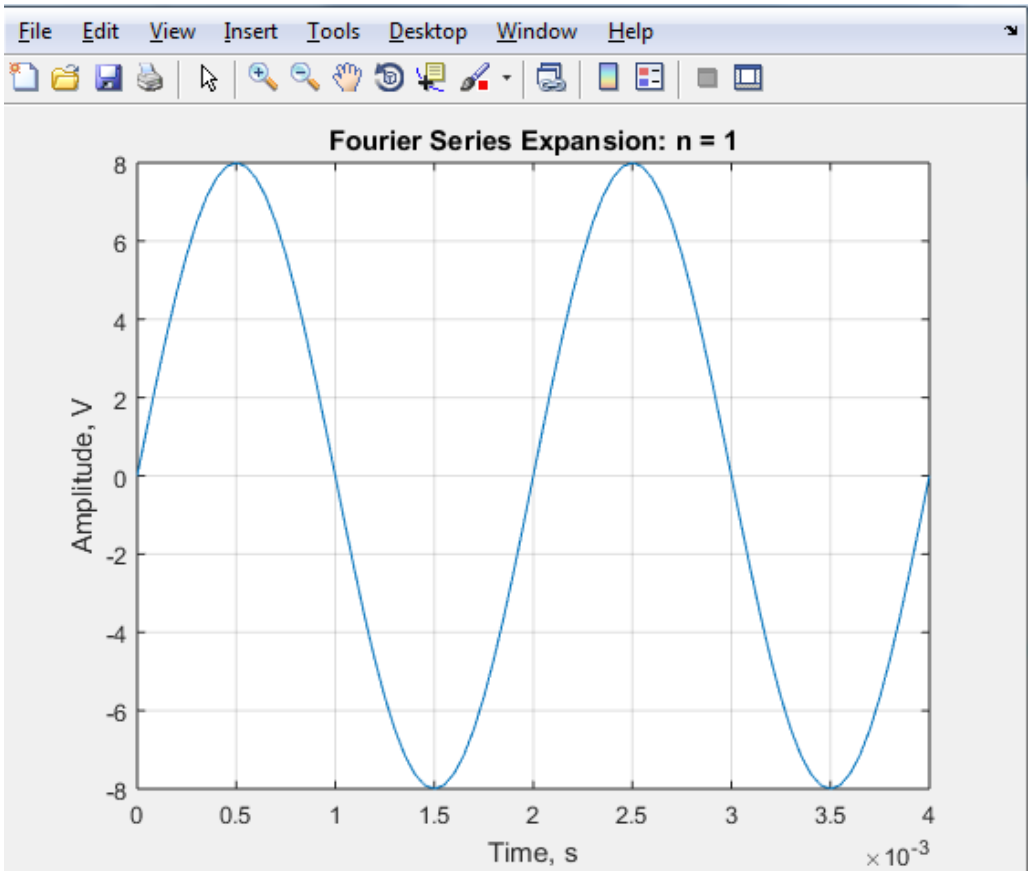

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 500
Amplitude, V
Time, s
×10^-3

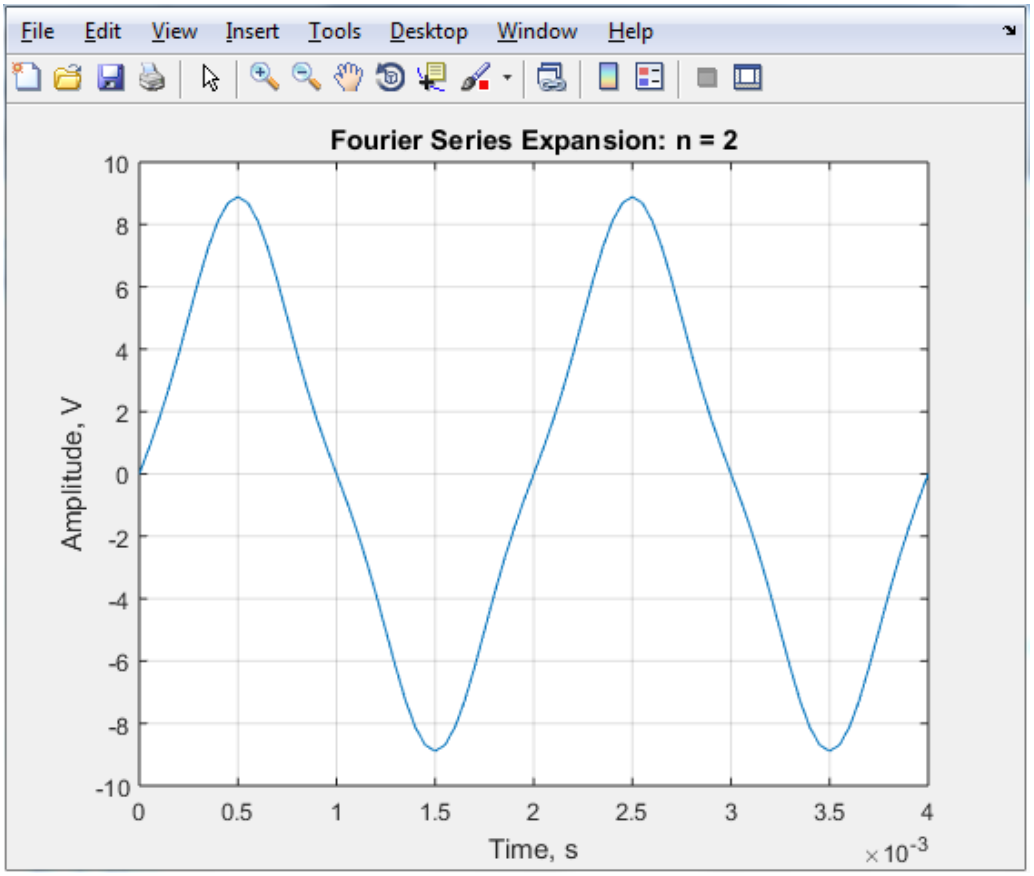
3.

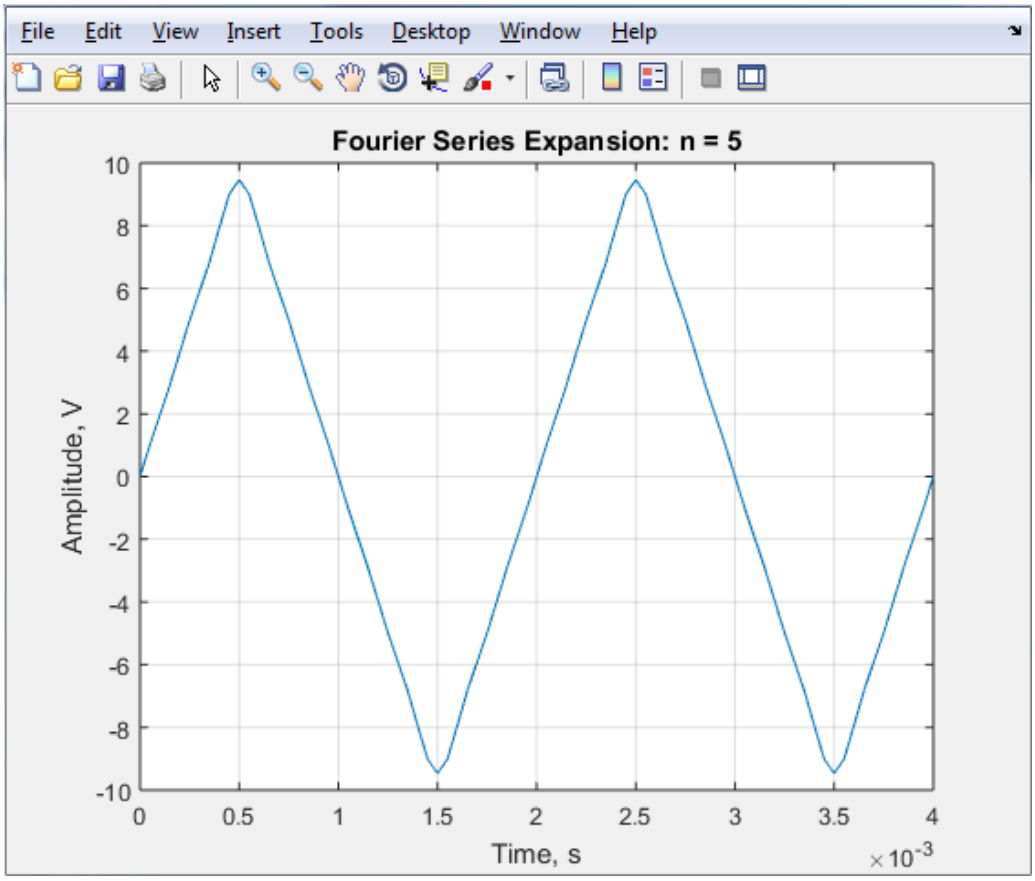
Editor - C:\Users\batch1\Desktop\Allen\T16.m

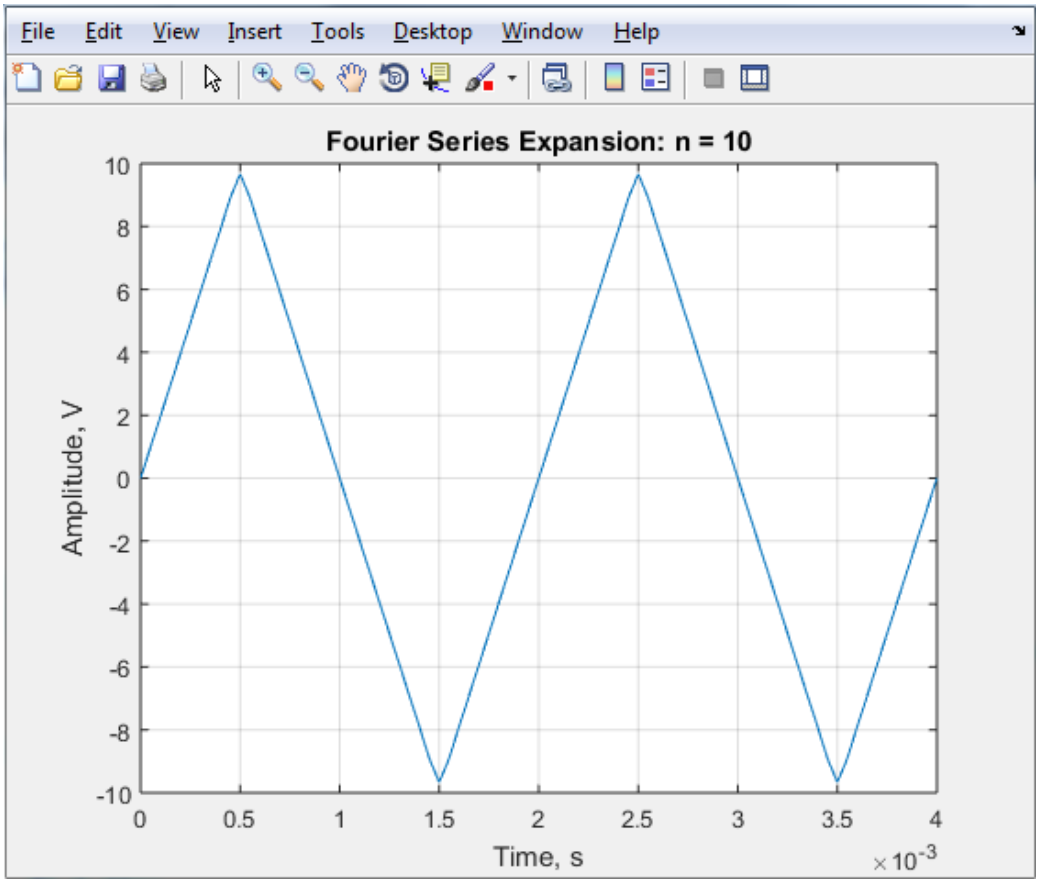
T14.m | T15.m | T16.m

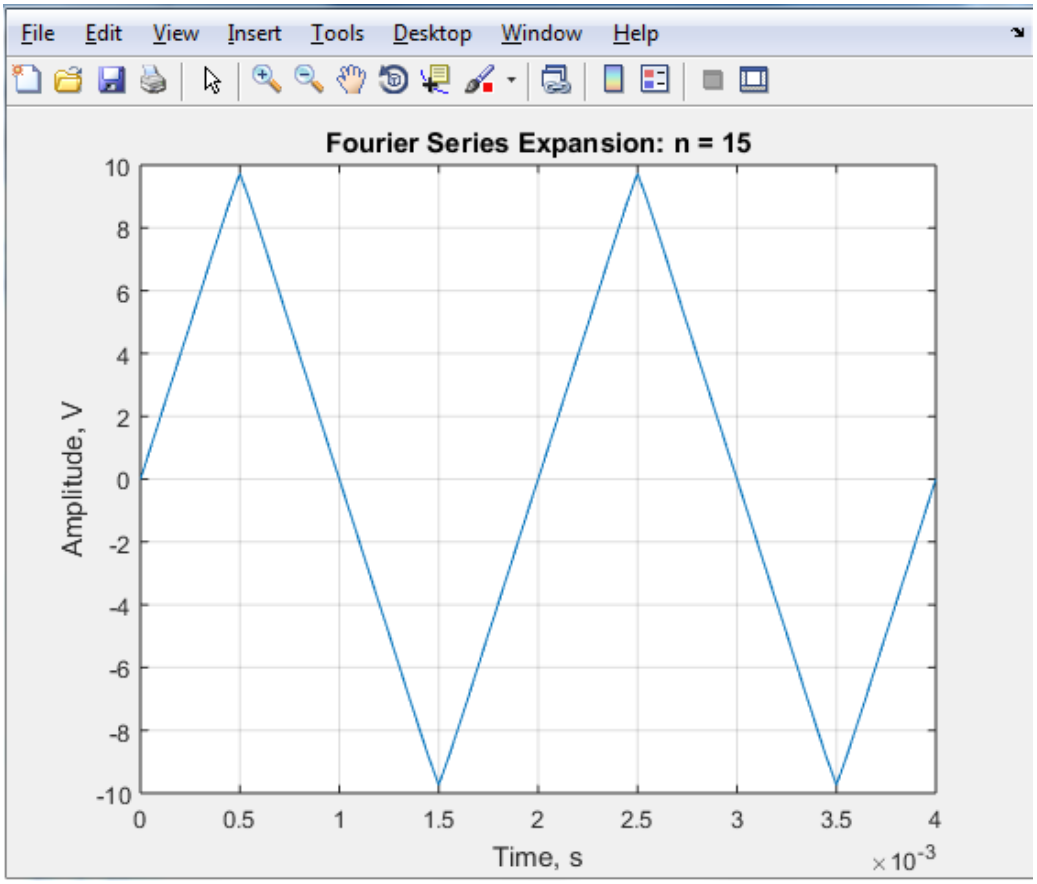
```
% 18BIS0043
clc
clear all
f = 500;
C = 4/pi;
dt = 5.0e-05;
totalpts = (4.0e-03/dt)+1

for n = 1:500
    for m = 1:totalpts
        s(n,m) = ((8/pi*pi).*((-1).^(n+1)).*sin((2*n-1)*2*pi*f*dt*(m-1))/(2*n-1).^2);
    end
end
for m = 1:totalpts
    a1 = s(:,m);
    a2(m) = sum(a1);
end
f1 = a2';
t = 0.0 : 5.0e-05 : 4.0e-03;

plot(t,f1)
grid on
xlabel('Time, s')
ylabel('Amplitude, V')
title('Fourier Series Expansion')
```

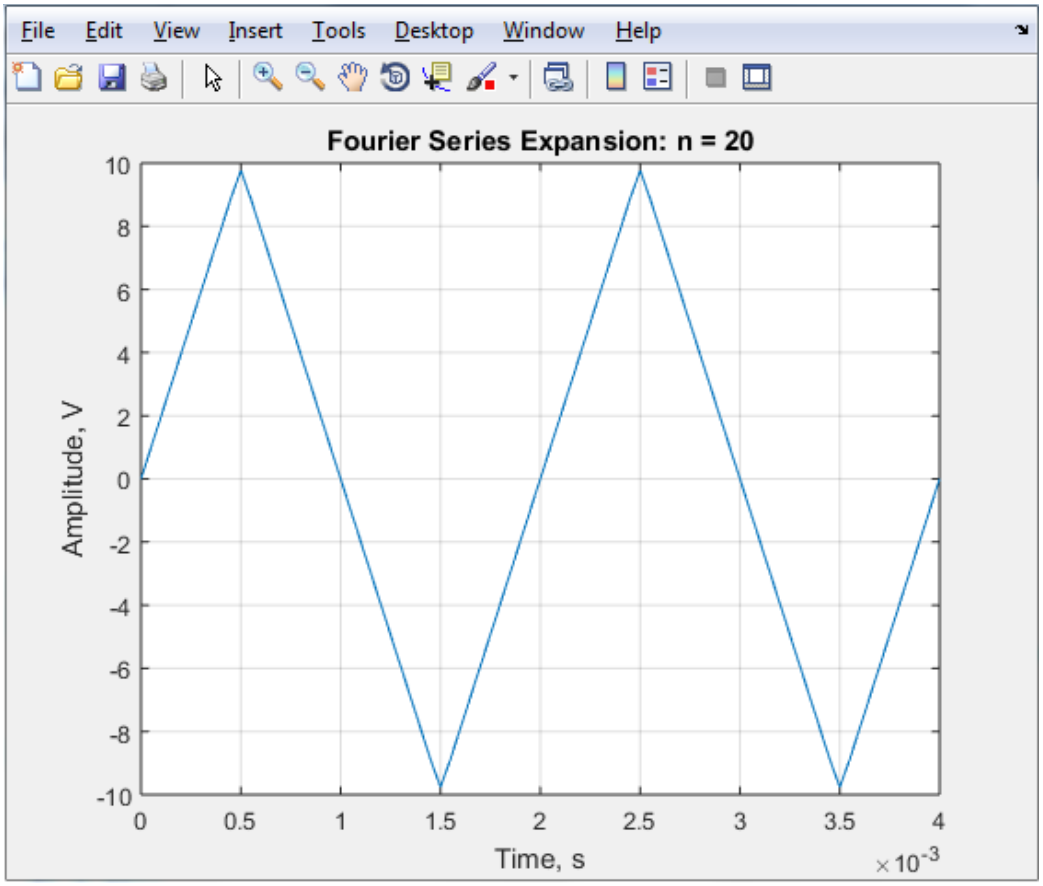

File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 1
Amplitude, V
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2
2.5
3
3.5
4
Time, s
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 2
Amplitude, V
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
0.5
1
1.5
2
2.5
3
3.5
4
Time, s
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 5
Amplitude, V
Time, s
×10^-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 10
Amplitude, V
Time, s
×10^-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 15
Amplitude, V
Time, s
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
0.5
1
1.5
2
2.5
3
3.5
4
×10-3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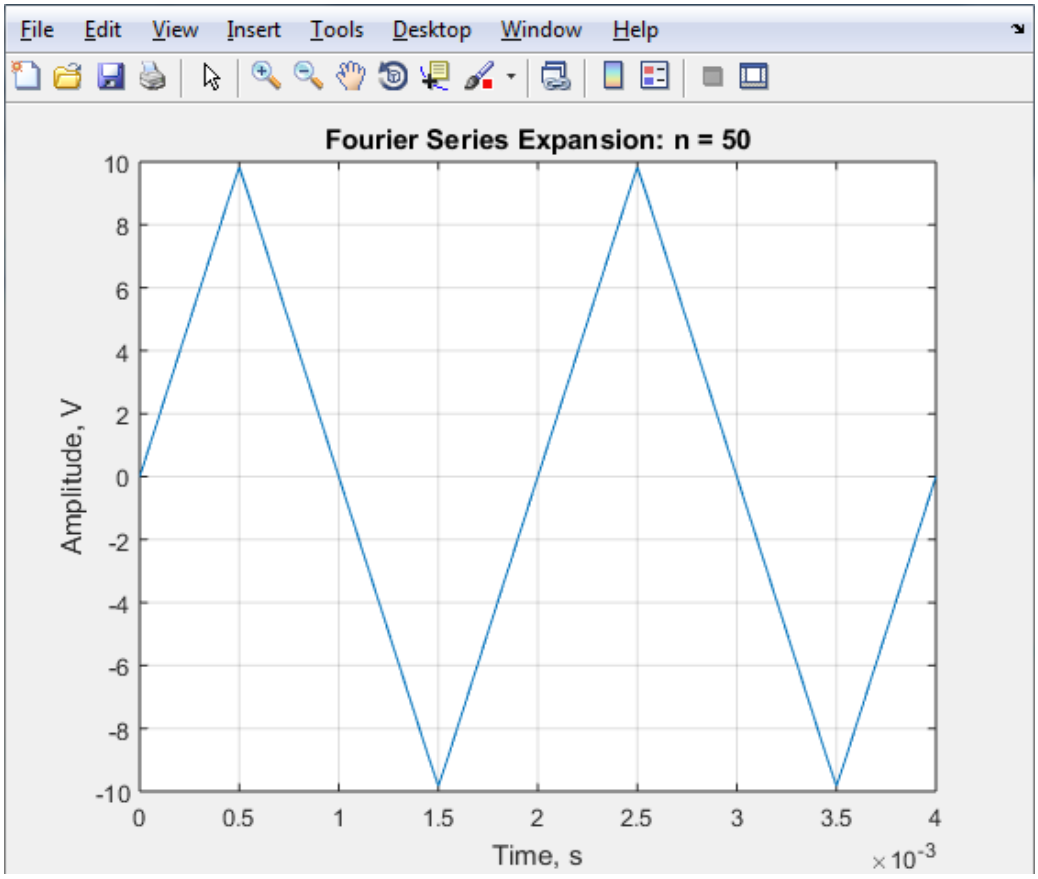
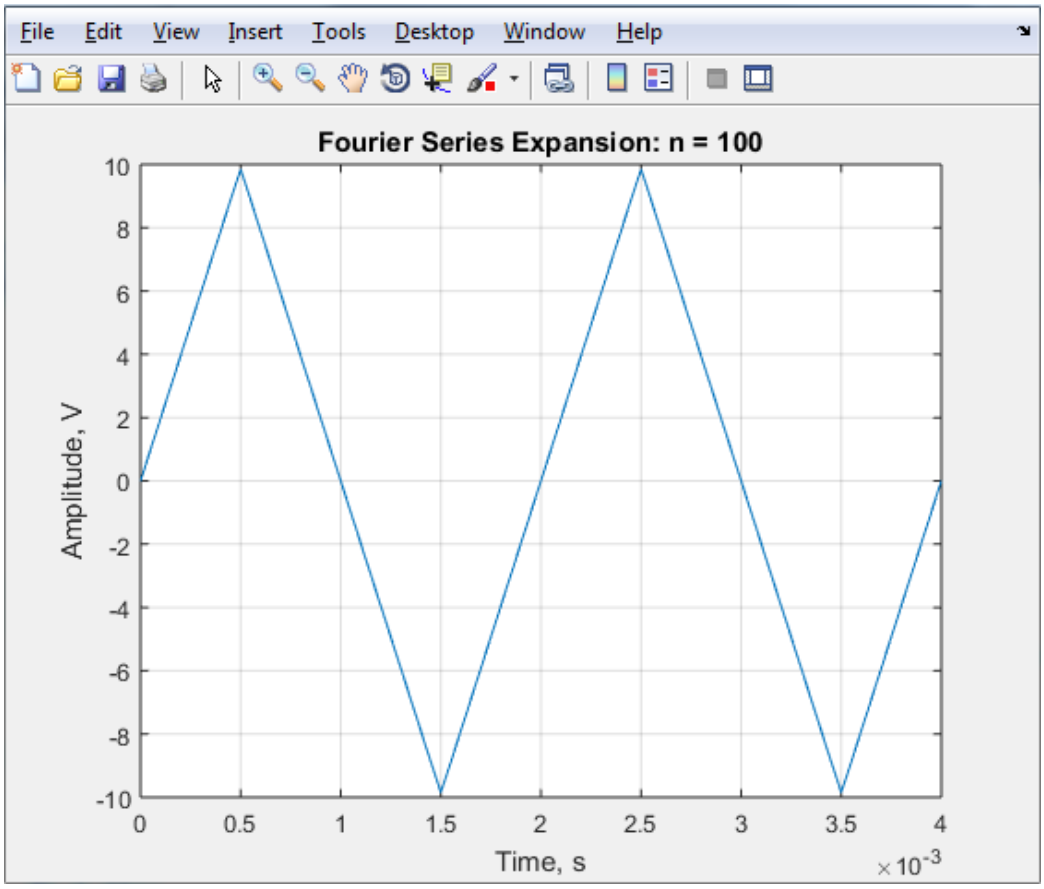
Fourier Series Expansion: n = 20
Amplitude, V
Time, s
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
0.5
1
1.5
2
2.5
3
3.5
4
×10-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 50
Amplitude, V
Time, s
×10^-3


File Edit View Insert Tools Desktop Window Help
Fourier Series Expansion: n = 100
Amplitude, V
Time, s
×10^-3