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Reg. No.: 19BCE2074

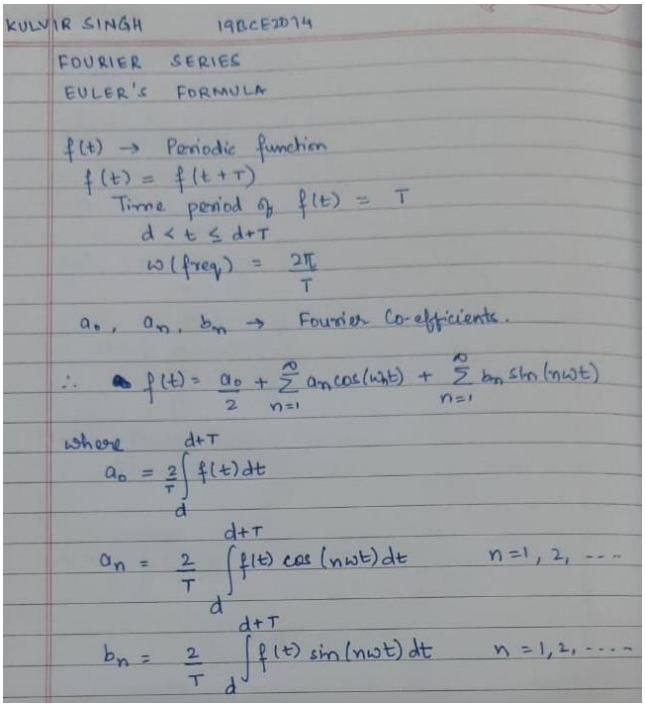
E-Record 1

Experiment 1A – Fourier Series Expansion

Aim:

Find the Fourier series of the function $f(t) = \begin{cases} 0, if -2 < t < -1 \\ 1, if -1 < t < 1 \\ 0, if 1 < t < 2 \end{cases}$

Mathematical Background: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FOURIER SERIES

EULER'S FORMULA

$f(t)$ → Periodic function

$f(t) = f(t+T)$

Time period of $f(t) = T$

$d < t \leq d+T$

ω (freq) $= \frac{2\pi}{T}$

a_0, a_n, b_n → Fourier Co-efficients.

$\therefore f(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos(n\omega t) + \sum_{n=1}^{\infty} b_n \sin(n\omega t)$

where

$a_0 = \frac{2}{T}\int_{d}^{d+T} f(t)\,dt$

$a_n = \frac{2}{T}\int_{d}^{d+T} f(t)\cos(n\omega t)\,dt \quad n = 1, 2, \ldots$

$b_n = \frac{2}{T}\int_{d}^{d+T} f(t)\sin(n\omega t)\,dt \quad n = 1, 2, \ldots$

MATLAB Code:

```
clc
clear all
close all
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```
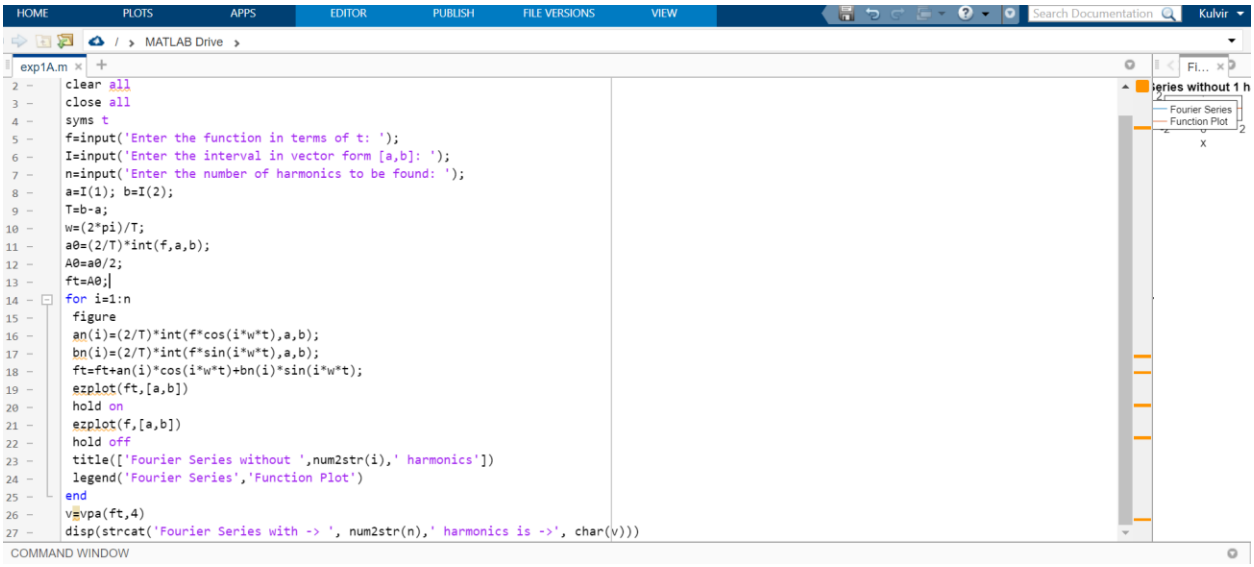

```
syms t
f=input('Enter the function in terms of t: ');
I=input('Enter the interval in vector form [a,b]: ');
n=input('Enter the number of harmonics to be found: ');
a=I(1); b=I(2);
T=b-a;
w=(2*pi)/T;
a0=(2/T)*int(f,a,b);
A0=a0/2;
ft=A0;
for i=1:n
 figure
 an(i)=(2/T)*int(f*cos(i*w*t),a,b);
 bn(i)=(2/T)*int(f*sin(i*w*t),a,b);
 ft=ft+an(i)*cos(i*w*t)+bn(i)*sin(i*w*t);
 ezplot(ft,[a,b])
 hold on
 ezplot(f,[a,b])
 hold off
 title(['Fourier Series without ',num2str(i),' harmonics'])
 legend('Fourier Series','Function Plot')
end
v=vpa(ft,4)
disp(strcat('Fourier Series with -> ', num2str(n),' harmonics is ->', char(v)))
```



Output:

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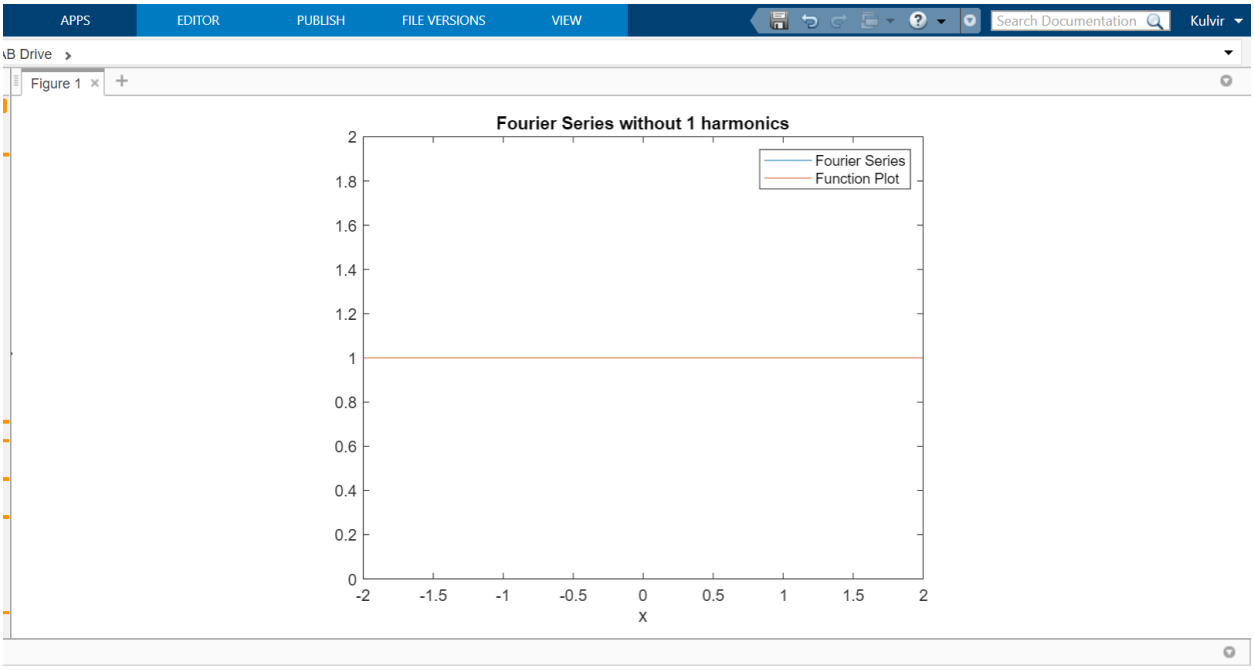

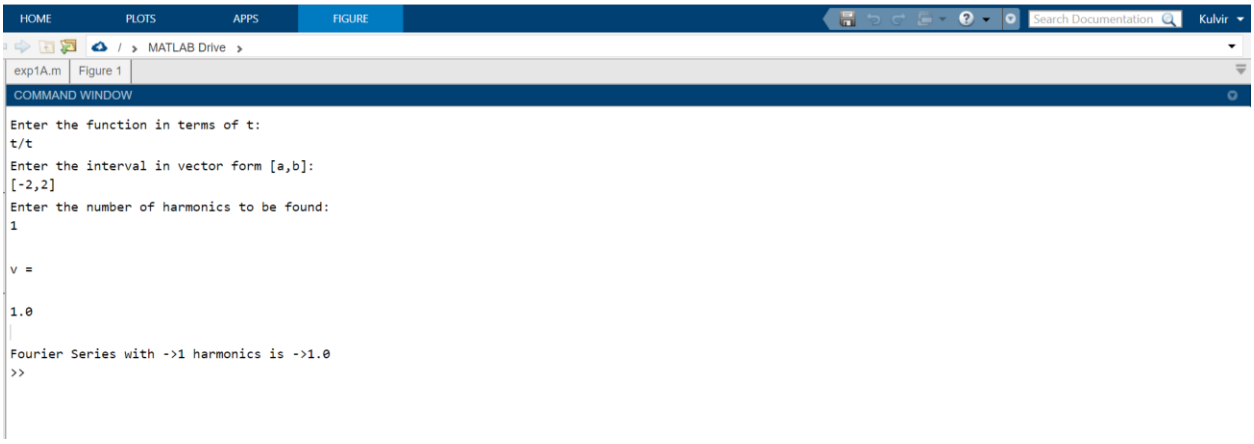

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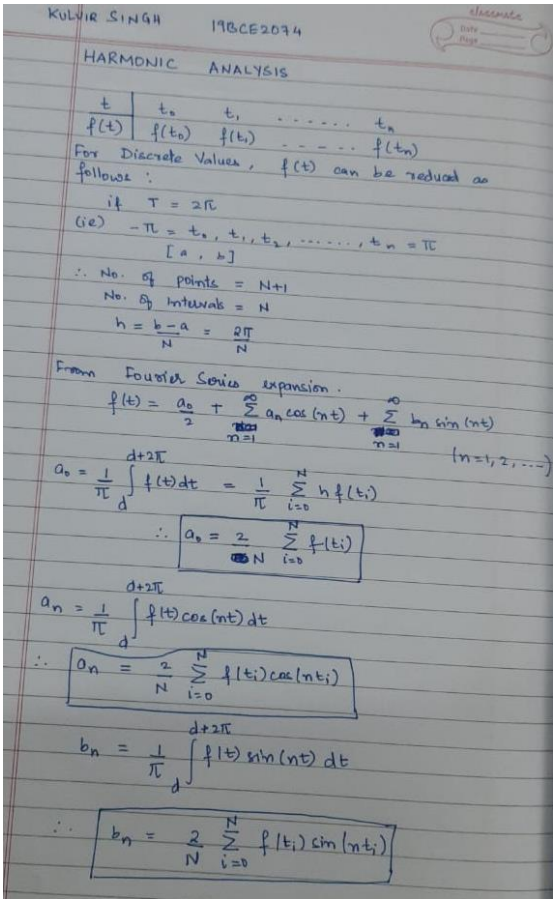
Experiment 1B – Harmonic Analysis

Aim:

Find the first two harmonics for the following data

t	0	$\pi/2$	π	$3\pi/2$
f(t)	1	2	3	4

Mathematical Background:



MATLAB Code:

```
clc
clear all
close all
syms x
t=input('Enter the value of t in row vector:');
f=input('Enter the f values in row vector:');
m=input('No. of harmonics to be found:');
N=numel(t);
h=2*pi/N;
c=input('Enter nonzero if t is not in radian:');
a0=(2/N)*sum(f);
if c==0
theta=t;
else
theta=t(1)+(0:N-1)*h
end
F_s=a0/2;
figure

A0=a0/2;
for i=1:m
yc=f.*cos(i*theta);
ys=f.*sin(i*theta);
an(i)=(2/N)*sum(yc);
bn(i)=(2/N)*sum(ys);
F_s=F_s+an(i)*cos(i*x)+bn(i)*sin(i*x);
subplot(1,m,1);
plot(t,f,'*r')
hold on
ezplot(F_s,[t(1),t(N)])
hold off
end
F_t=vpa(F_s,5)
```

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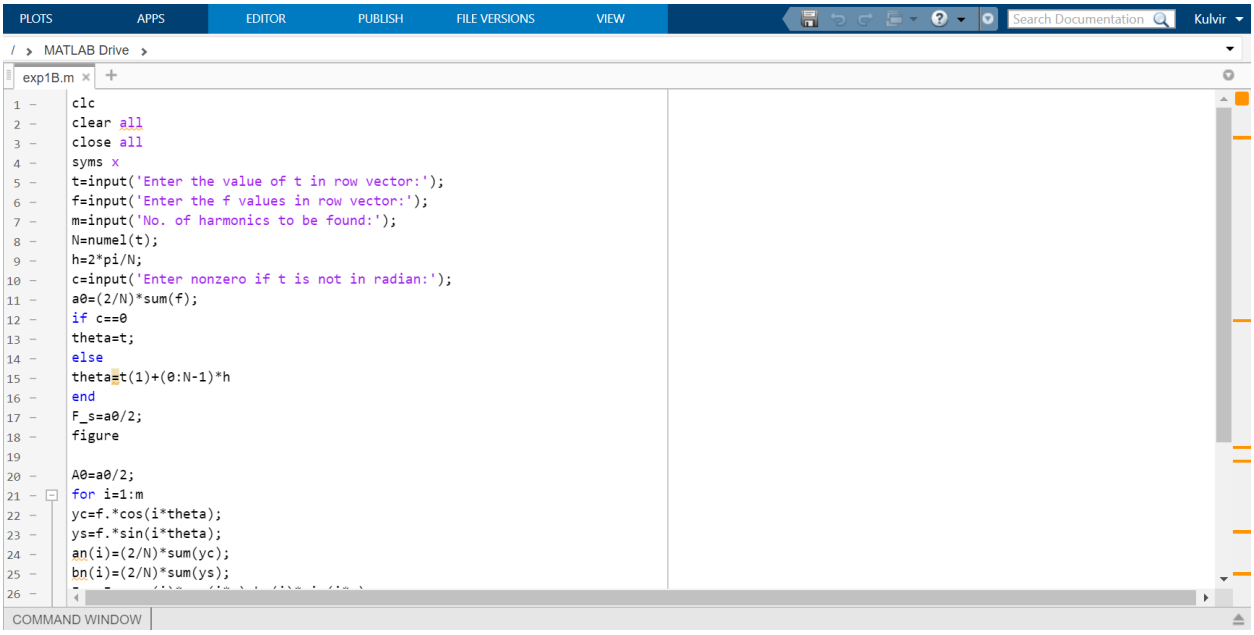

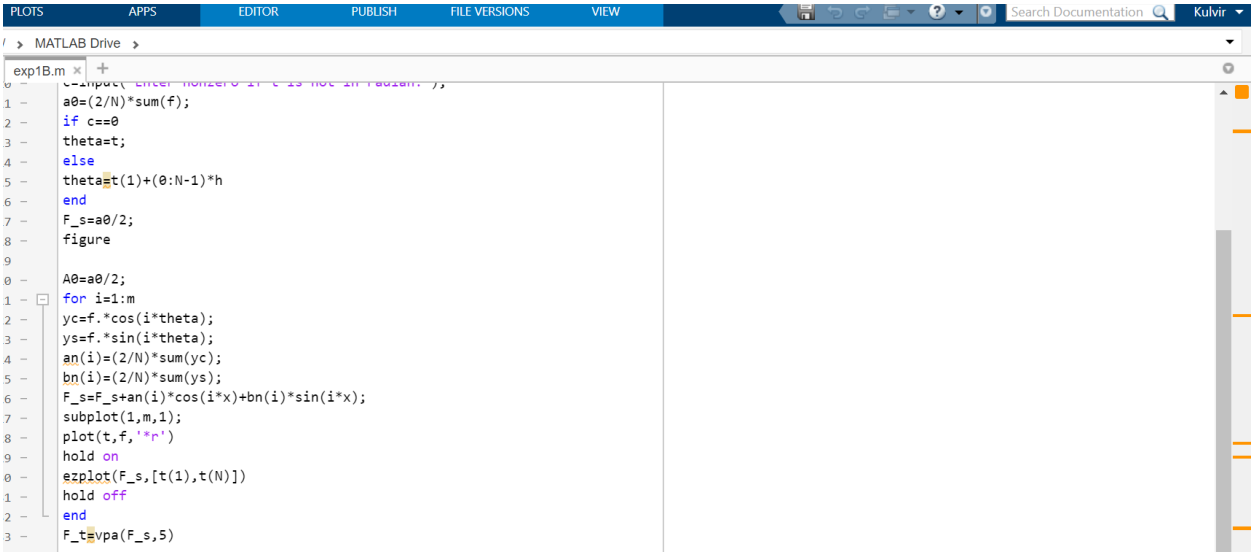

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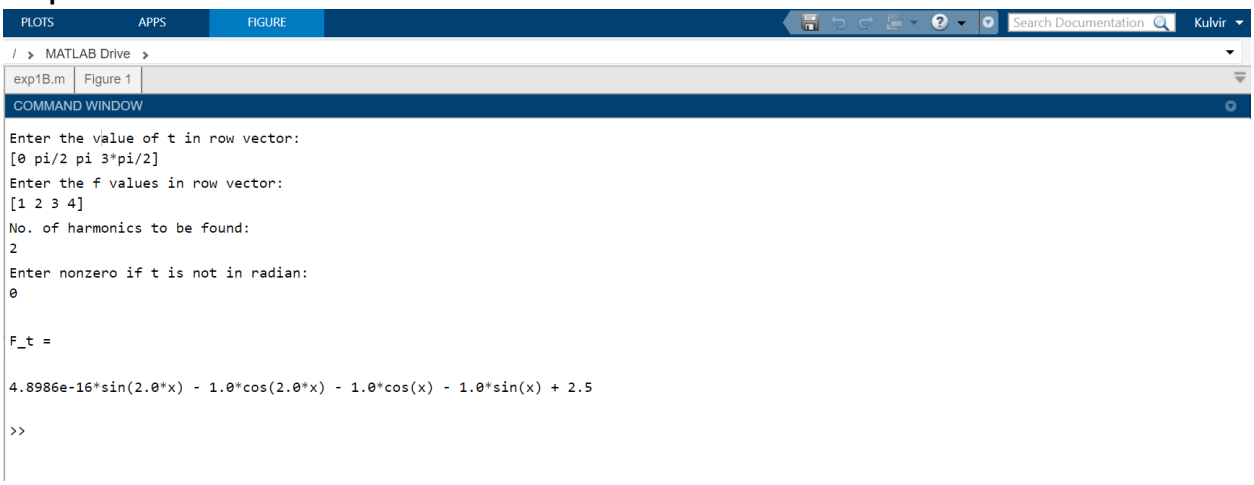
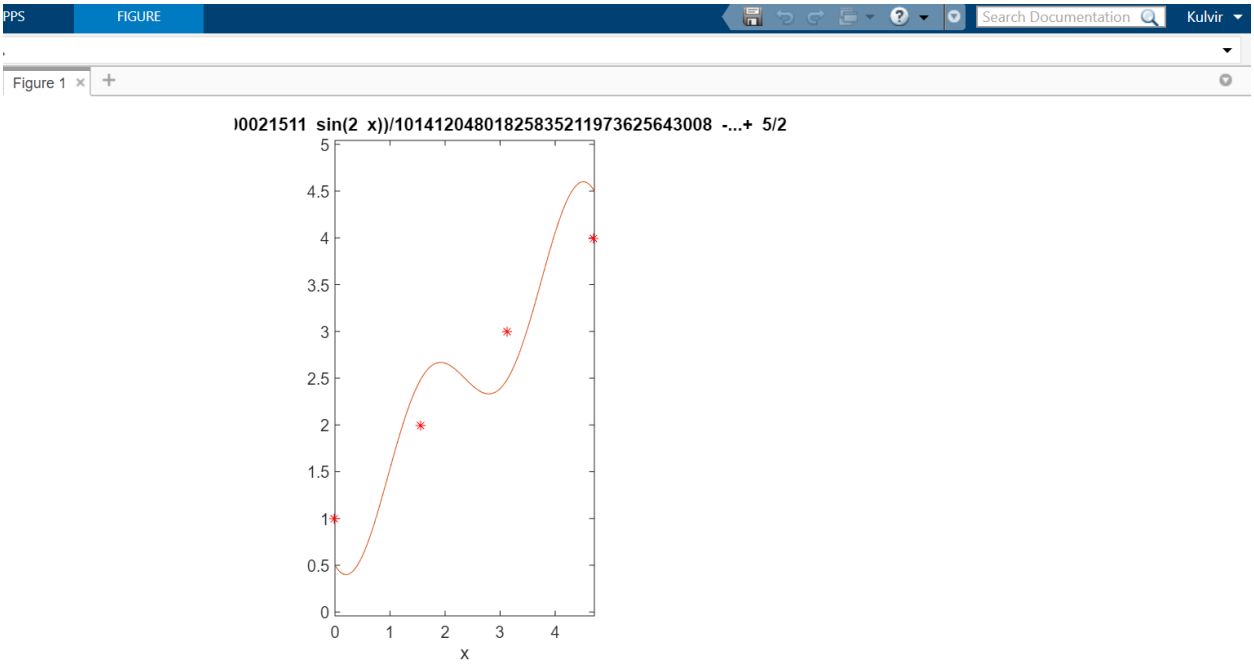
Output:





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