**MAT1002 Lab Experiment No. 7** **17/04/2021**

**NAME : KHAN MOHD. OWAIS RAZA**
**REGISTRATION NO. : 20BCD7138**

**Aim**: to find Fourier series of the given function in an interval [a, b] and visualize it using MATLAB.

Fourier series of the function $f(x)$ on the interval $[-L, L]$ is given by

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty} a_n \cos\left(\frac{n\pi x}{L}\right)+b_n \sin\left(\frac{n\pi x}{L}\right)$$

where

$$a_0=\frac{1}{L}\int_{L} f(x)dx,\ a_n=\frac{1}{L}\int_{L} f(x)\cos\frac{n\pi x}{L}dx, b_n=\frac{1}{L}\int_{L} f(x)\sin\frac{n\pi x}{L}dx$$

**Exercise:**

Find the Fourier series of the function

$f(x)=|x|,-2<x<2$

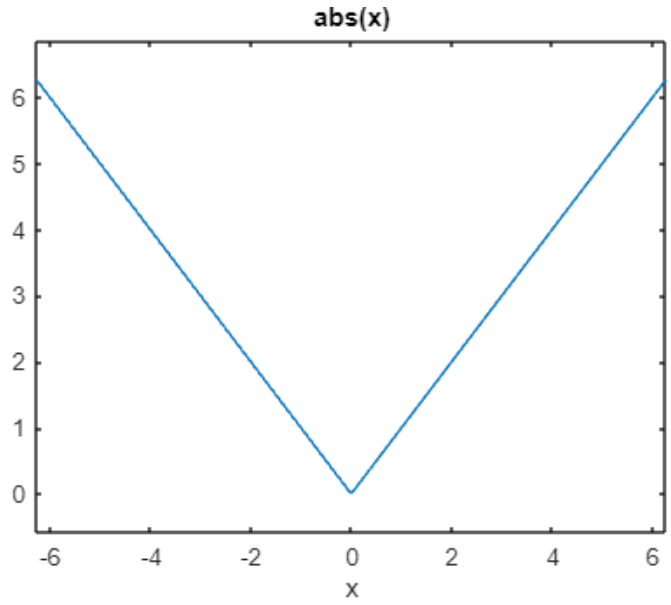
and visualize it.

```
clc
clear all
syms x
L=input('the value of L');
 f=input('Enter the function of x');
 n=input('Enter the number of terms of series');
 d=(1/(2*L))*int(f,x,-L,L);
For j=1:n
 for k=1:1i
  a(k)=(1/L)*int(f*cos((k*pi*x)/L),x,-L,L);
  c(k,1)=cos((k*pi*x)/L);
  b(k)=(1/L)*int(f*sin((k*pi*x)/L),x,-L,L);
  s(k,1)=sin((k*pi*x)/L);
 end
f_r(1i)=d+a*c+b*s;
h1=ezplot(f_r(j));
 hold all
hold on
 h2=ezplot(f);
```

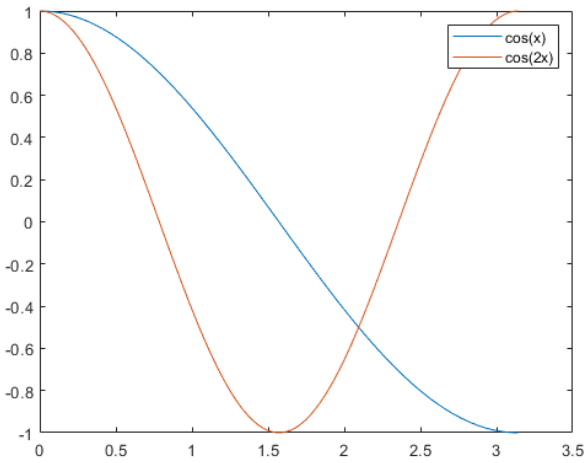
```
hold off
 set(h1,'color','g','linestyle','-')
 legend('1st','2nd','3rd','4th','5th', 'f')
```

OUTPUT:

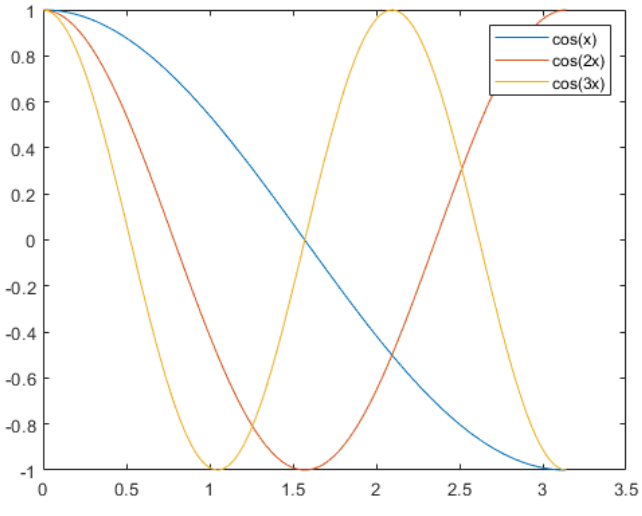
```
the value of L

2

Enter the function of x

abs(x)

Enter the number of terms of series

n=5

d=(1/(2*L))*int(f,x,-L,L)


d = 1
```



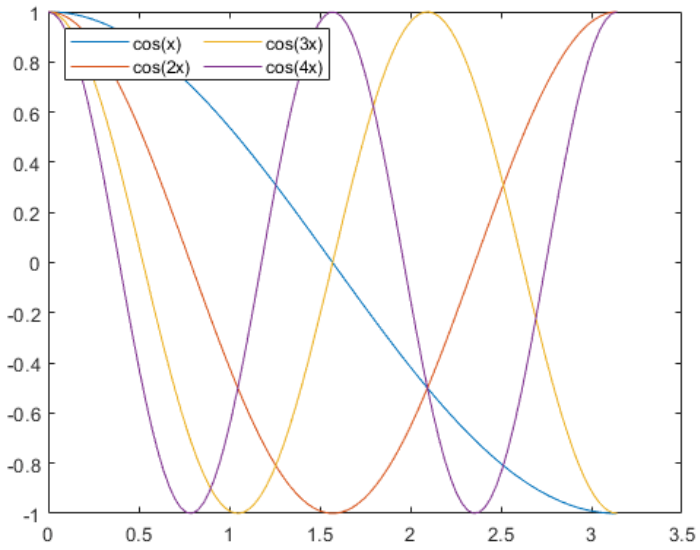

```
x = linspace(0,pi);
y1 = cos(x);
plot(x,y1)

hold on
y2 = cos(2*x);
plot(x,y2)

legend('cos(x)','cos(2x)')
```




```
y3 = cos(3*x);
plot(x,y3,'DisplayName','cos(3x)')
hold off
```



```
x = linspace(0,pi);
y1 = cos(x);
plot(x,y1)

hold on
y2 = cos(2*x);
plot(x,y2)

y3 = cos(3*x);
plot(x,y3)

y4 = cos(4*x);
plot(x,y4)
hold off
```




```
legend({'cos(x)','cos(2x)','cos(3x)','cos(4x)'},'Location','northwest'
,'NumColumns',2)
```

**Exercise:**

Find the Fourier series of the function $f(x) = x + x^2/4$ and visualize it.

**MATLAB Code:**

```
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clear all
syms x
L=input('the value of L');
 f=input('Enter the function of x');
 n=input('Enter the number of terms of series');
 d=(1/(2*L))*int(f,x,-L,L);
For j=1:n
 for k=1:1i
  a(k)=(1/L)*int(f*cos((k*pi*x)/L),x,-L,L);
  c(k,1)=cos((k*pi*x)/L);
  b(k)=(1/L)*int(f*sin((k*pi*x)/L),x,-L,L);
  s(k,1)=sin((k*pi*x)/L);
 end
f_r(1i)=d+a*c+b*s;
h1=ezplot(f_r(j));
 hold all
hold on
h2=ezplot(f);
hold off
 set(h1,'color','g','linestyle','-')
 legend('1st','2nd','3rd','4th','5th', 'f')
```
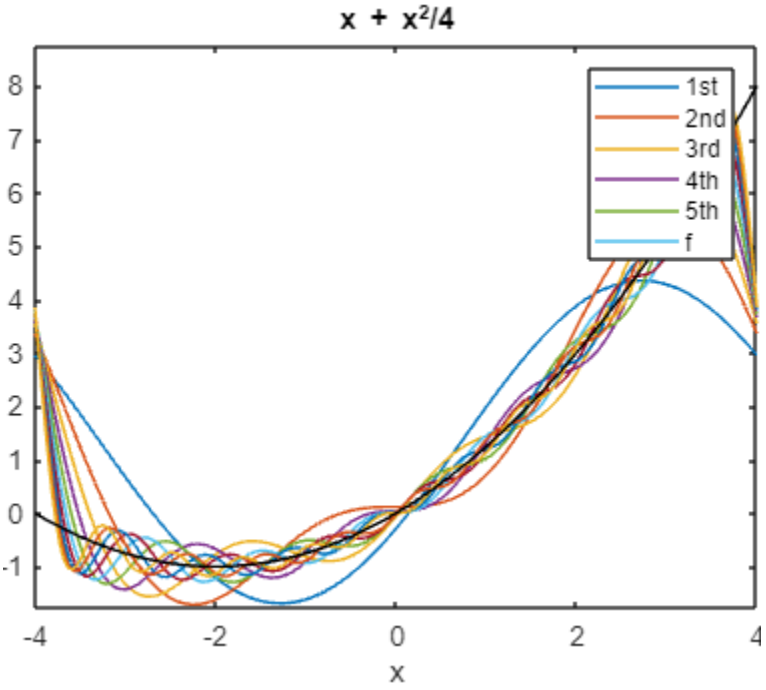

**OUTPUT:**




**Exercise:**

Find the Fourier series of the function

$f(x)=|x|,-2<x<2$

and visualize it.

MATLAB Code:

```
clc
clear all
syms x
L=input('the value of L');
f=input('Enter the function of x');
n=input('Enter the number of terms of series');
d=(1/(2*L))*int(f,x,-L,L);
for j=1:n
 for k=1:j
      a(k)=(1/L)*int(f*cos((k*pi*x)/L),x,-L,L);
      c(k,1)=cos((k*pi*x)/L);
      b(k)=(1/L)*int(f*sin((k*pi*x)/L),x,-L,L);
      s(k,1)=sin((k*pi*x)/L);
 end
f_r(j)=d+a*c+b*s;
h1=ezplot(f_r(j));
hold all
```

```
end
hold on
h2=ezplot(f,[-L L]);
hold off
```

MATLAB Output:

```
the value of L

2

Enter the function of x

abs(x)

Enter the number of terms of series

n=5

d=(1/(2*L))*int(f,x,-L,L)


d = 1
```