MATLAB code Week 4
Integration: Indefinite, definite and Area between the curves

MATLAB Syntax used:

int(f,v)	uses the symbolic object v as the variable of integration, rather than the variable determined by symvar
rsums(f, [a, b])	rsums(f, a, b) and rsums(f, [a, b]) approximates the integral for *x* from a to b.
fill(X,Y,C)	fill(X,Y,C) creates filled polygons from the data in X and Y with vertex color specified by C.
char(X)	converts array X of nonnegative integer codes into a character array.

A. Integration

i) Inbuilt MATLAB function:

```
syms x
f=input('enter the function f(x):');
a=input('enter lower limit of x ');
b=input('enter the upper limit of x');
n=input('number of intervals');
z=int(f,a,b) % direct evaluation
```

ii) As a sum of rectangles by using rsums command :

→**Initialization:**

```
value = 0;
dx = (b-a)/n;
```

→ **sum of the function values at all the right points**

```
for k=1:n
    c = a+k*dx;
    d=subs(f,x,c);
    value = value + d;
end
```

→ **value of the sum* length of the sub interval is the approx. value of the integral**

```
ivalue = dx*value
ezplot(f,[a b])
```

→ **Taking mid point function values**

```
rsums(f, a, b)
```

Problems:

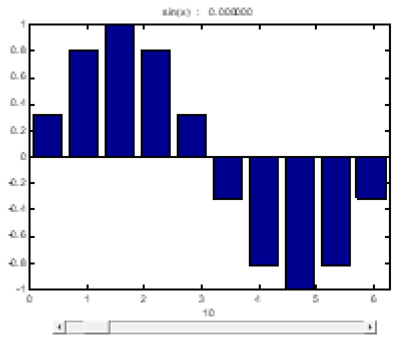
1) Sin(x) in [0, 2 pi]

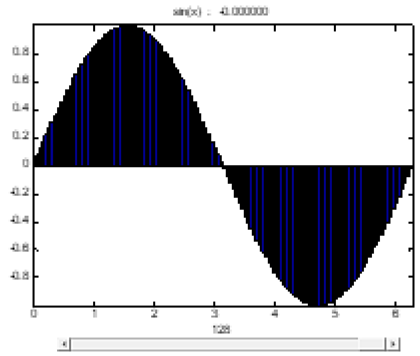
Output

```
enter the function f(x):sin(x)
                    enter lower limit of x 0
                    enter the upper limit of x2*pi
```

```
number of intervals10

z =

0

value =

-1.5389e-016

 z =

0
```

Figure Window:





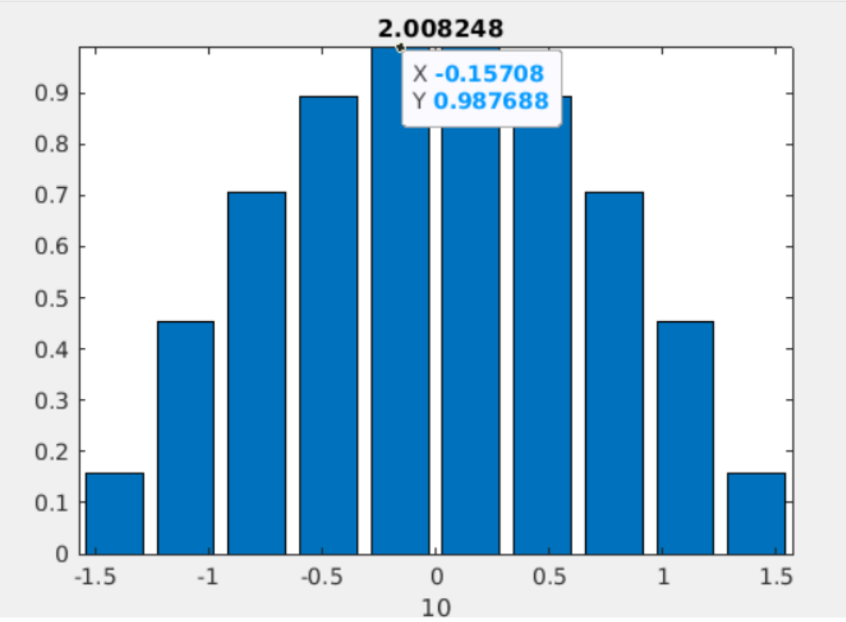
2) Cos(x) in [-pi/2, pi/2]

<u>Output</u>

```
enter the function f(x):
cos(x)
enter lower limit of x
-pi/2
enter the upper limit of x
pi/2
number of intervals
10

z =

2
```

```
value =

(pi*((2^(1/2)*(5 - 5^(1/2))^(1/2))/2 + 5^(1/2) + (2^(1/2)*(5^(1/2) + 5)^(1/2))/2 +
1))/10


z =

2
```

Figure Window:

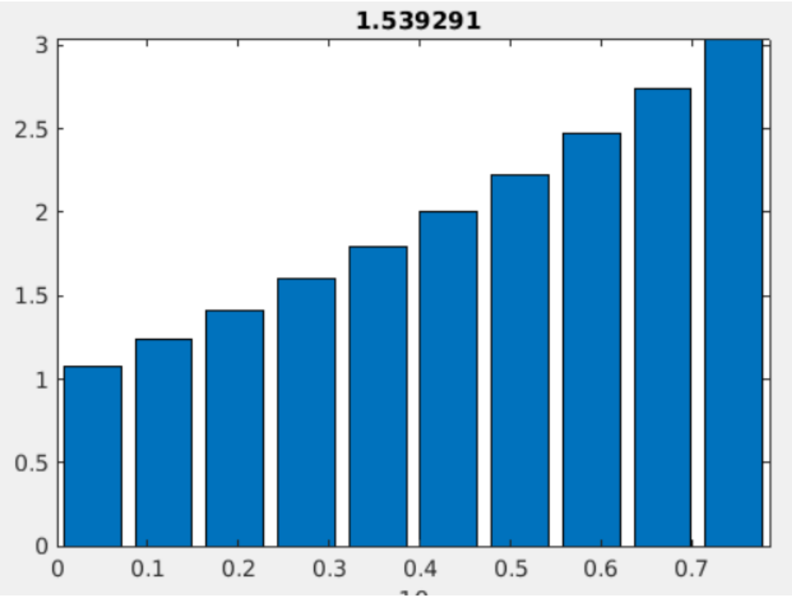


3) e^x+tan(x)

Output

```
enter the function f(x):
exp(x)+tan(x)
enter lower limit of x
0
enter the upper limit of x
pi/4
number of intervals
10

z =

exp(pi/4) + log(2)/2 - 1


value =
```

```
(pi*(exp(pi/4) + exp(pi/5) + exp(pi/8) + exp(pi/10) + exp(pi/20) + exp((3*pi)/20) +
exp(pi/40) + exp((3*pi)/40) + exp((7*pi)/40) + exp((9*pi)/40) + tan(pi/20) +
tan((3*pi)/20) + tan(pi/40) + tan((3*pi)/40) + tan((7*pi)/40) + tan((9*pi)/40) +
(5^(1/2)*(5 - 2*5^(1/2))^(1/2))/5 + 2^(1/2) + (5 - 2*5^(1/2))^(1/2)))/40


z =

exp(pi/4) + log(2)/2 - 1
```



B. Area between the curves:

```
clc
clear all
close all
syms x
y1=input('ENTER THE Y1 REGION VALUE');
y2=input('ENTER THE Y2 REGION VALUE');
t=solve(y1-y2); %(Y1-Y2=0)
po=double(t)
poi=sort(po)
n=length(poi)
m1=min(poi)
m2=max(poi)

ez1=ezplot(y1,[m1-1,m2+1])
hold on
TA=0
ez2=ezplot(y2,[m1-1,m2+1])
if n>2
```

```
  for i=1:n-1
  A=int(y1-y2,poi(i),poi(i+1))
  TA= TA+abs(A)
  x1 = linspace(poi(i),poi(i+1))
  yy1 =subs(y1,x,x1)
  yy2 = subs(y2,x,x1)

%iii)  Creating a polygon:

xx = [x1,fliplr(x1)]
yy = [yy1,fliplr(yy2)]
fill(xx,yy,'g')
grid on
  end
else

A=int(y1-y2,poi(1),poi(2))
TA=abs(A)
x1 = linspace(poi(1),poi(2));
yy1 =subs(y1,x,x1)
yy2 = subs(y2,x,x1)
xx = [x1,fliplr(x1)]
yy = [yy1,fliplr(yy2)]
fill(xx,yy,'g')
end
```

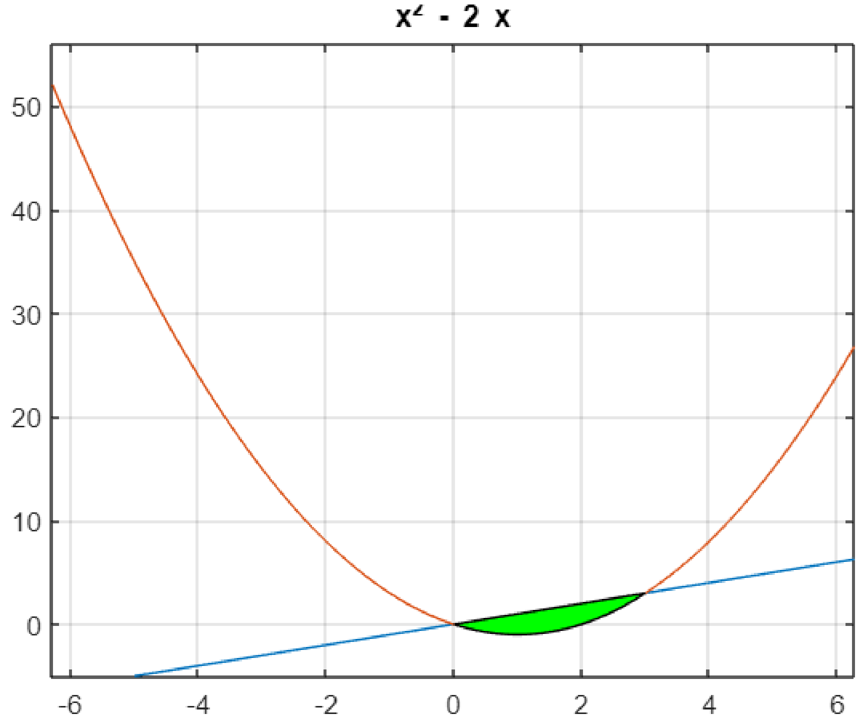
Problems:

4) Find the area of the regions enclosed by the curves, $y = x^2 - 2x, y = x$

Output

```
ENTER THE Y1 REGION VALUE
x
ENTER THE Y2 REGION VALUE
x^2-2*x

f =

9/2

kokler =

     0
     3


f =
```

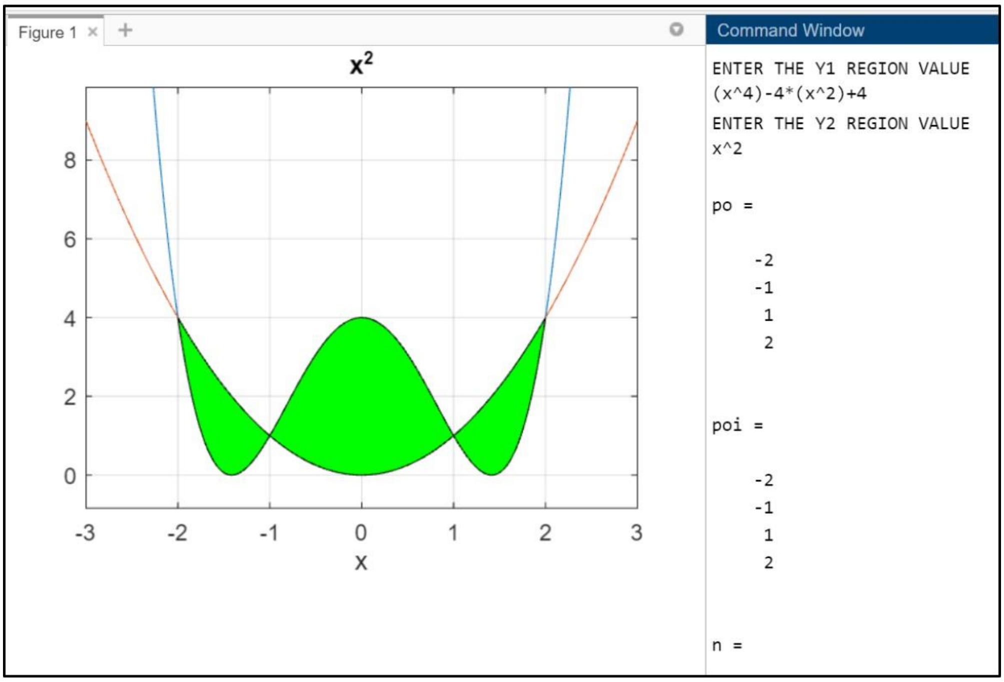
9/2



5) Find the area of the regions enclosed by the curves $y = x^4 - 4x^2 + 4, y = x^2$

Output:

$y_1 = x^4 - 4x^2 + 4$ $y_2 = x^2$



MATLAB code Week 5

Volume of Solid of Revolution

Aim: To find the volume of a solid generated by revolving a curve about the $x-$axis

The solid generated by rotating (or revolving) a plane region about an axis in its plane is called a **solid of revolution**. In this exercise, we will only consider solids of revolution that are generated by rotations about axes that are parallel to the $x-$ axis. The solid of revolutions that are generated about axes that are parallel to the $y-$axis can be obtained by appropriate modifications to the code.

The volume of solid generated by rotating a curve $y = f(x)$ about $x-$axis, can be found using **disk method**, which is given by

$$V = \int_a^b \pi[R(x)]^2 \, dx.,$$

where $R(x)$ is the radius, the distance of the planar region's boundary from the axis of revolution. If the solid is generated by rotating about a line $y = c$ $(f(a) < c < f(b))$ parallel to $x-$axis, then the volume is:

$$V = \int_a^b \pi[R(x) - c]^2 \, dx.$$

The definite integration of any function, $f(x)$ between the limits, $[a, b]$ can be evaluated in the MATLAB using `int` command. The syntax is:

```
area = int(f,a,b);
```

We will below demonstrate the evaluation of volume of a solid of revolution using disk method and visualizing it.

```
clc
clear all
close all
%%
syms x;
f = input('Enter the function: ');
fL = input('Enter the interval on which the function is defined: ');
yr = input('Enter the axis of rotation y = c (enter only c value): ');
iL = input('Enter the integration limits: ');
Volume = pi*int((f-yr)^2,iL(1),iL(2));
sprintf('Volume is %3f ', double(Volume))
%% Shading the area between the axis of rot. and function
fx = inline(vectorize(f));
xvals = linspace(fL(1),fL(2),201);
xvalsr = fliplr(xvals);
xivals = linspace(iL(1),iL(2),201);
xivalsr = fliplr(xivals);
xlim = [fL(1) fL(2)+0.5];
ylim = fx(xlim);
figure('Position',[100 200 560 420])
subplot(2,1,1)
hold on;
plot(xvals,fx(xvals),'k-','LineWidth',2);
plot([fL(1) fL(2)],[yr yr],'r-','LineWidth',2);
 fill([xivals xivalsr],[fx(xivals) ones(size(xivalsr))*yr],[0.8 0.8 0.8],'FaceAlpha',0.8)
```

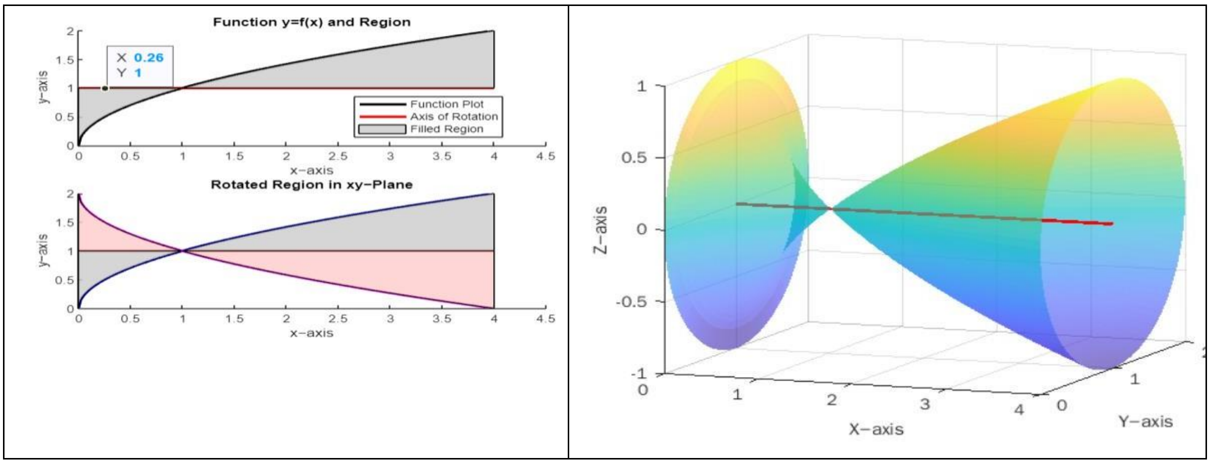
```
%% Marking the axis
%plot([fL(1) fL(2)],[yr yr],'r-','LineWidth',2);
legend('Function Plot','Axis of Rotation', 'Filled Region','Location','Best');
title('Function y=f(x) and Region');
set(gca,'XLim',xlim)
xlabel('x−axis');
ylabel('y−axis');
%% Plotting reflection of the curve about the axis of rot
subplot(2,1,2)
hold on;
plot(xivals,fx(xivals),'b-','LineWidth',2);
plot([iL(1) iL(2)],[yr yr],'r-','LineWidth',2);
fill([xivals xivalsr],[fx(xivals) ones(size(xivalsr))*yr],[0.8 0.8 0.8],'FaceAlpha',0.8)
plot(xivals,-fx(xivals)+2*yr,'m-','LineWidth',2);
fill([xivals xivalsr],[ones(size(xivals))*yr -fx(xivalsr)+2*yr],[1 0.8 0.8],'FaceAlpha',0.8)
title('Rotated Region in xy−Plane');
set(gca,'XLim',xlim)
xlabel('x−axis');
ylabel('y−axis');
%% Solid
[X,Y,Z] = cylinder(fx(xivals)-yr,100);
figure('Position',[700 200 560 420])
Z = iL(1) + Z.*(iL(2)-iL(1));
surf(Z,Y+yr,X,'EdgeColor','none','FaceColor','flat','FaceAlpha',0.6);
hold on;
plot([iL(1) iL(2)],[yr yr],'r-','LineWidth',2);
xlabel('X−axis');
ylabel('Y−axis');
zlabel('Z−axis');
view(21,11);
```

Problems:

1) Find the volume of the solid generated by revolving the region bounded by $y = \sqrt{x}, o \leq x \leq 4$ about the line $y = 1$

Output:

```
Enter the function:
sqrt(x)
Enter the interval on which the function is defined: [0
4]
Enter the axis of rotation y = c (enter only c value): 1
Enter the integration limits:
[0 4]

ans =

    'Volume is 4.188790e+00
```



2) Find the volume of the solid generated by revolving the region bounded by $y = sin\, x, o \leq x \leq \pi$ about the line $y = c, o \leq c \leq 1, c = 0,0.2,0.4.0.6,0.8,1.0$. Can you identify the range or exact value of c that minimize and maximize the volume of the solid?

Output:

For C=0

Enter the function:

sin(x)

Enter the interval on which the function is defined: [0 pi]

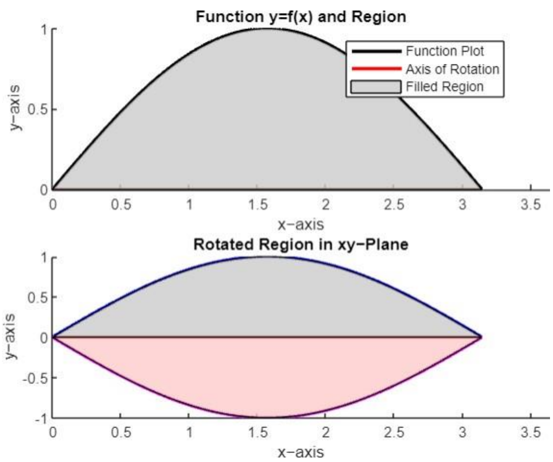
Enter the axis of rotation y = c (enter only c value): 0

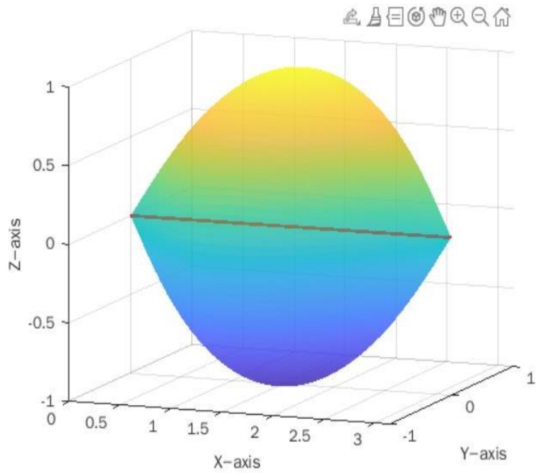
Enter the integration limits:

[0 pi]

ans =

'Volume is 4.934802e+00 '





For c=0.2

Enter the function:

sin(x)

Enter the interval on which the function is defined: [0
pi]

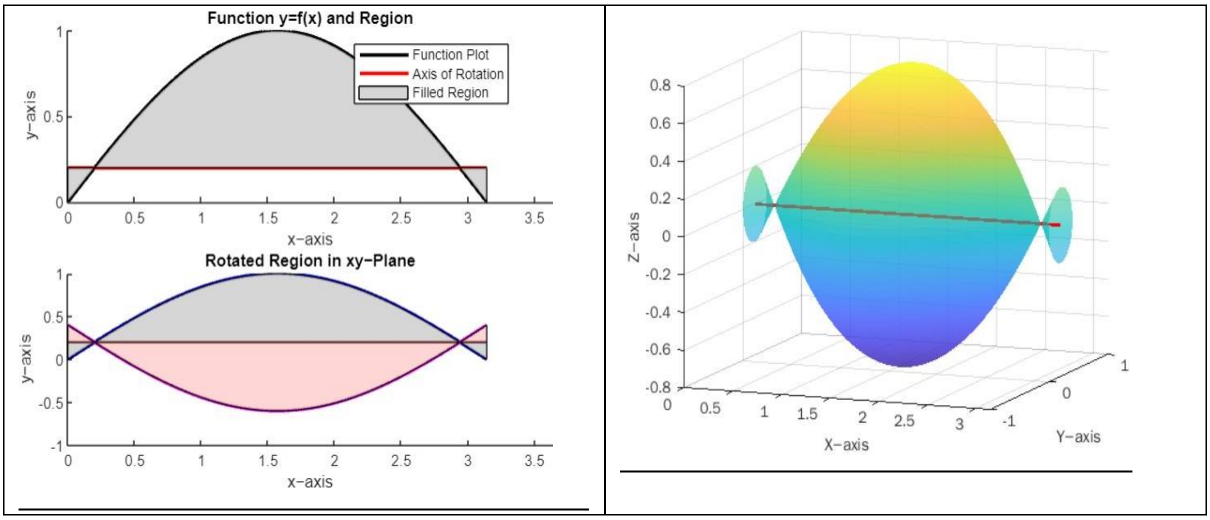
Enter the axis of rotation y = c (enter only c value): 0.2

Enter the integration limits:

[0 pi]

ans =

    'Volume is 2.816312e+00 '



For c=0.4

f =

 sin(x)

fL =

        0   3.1416

yr =

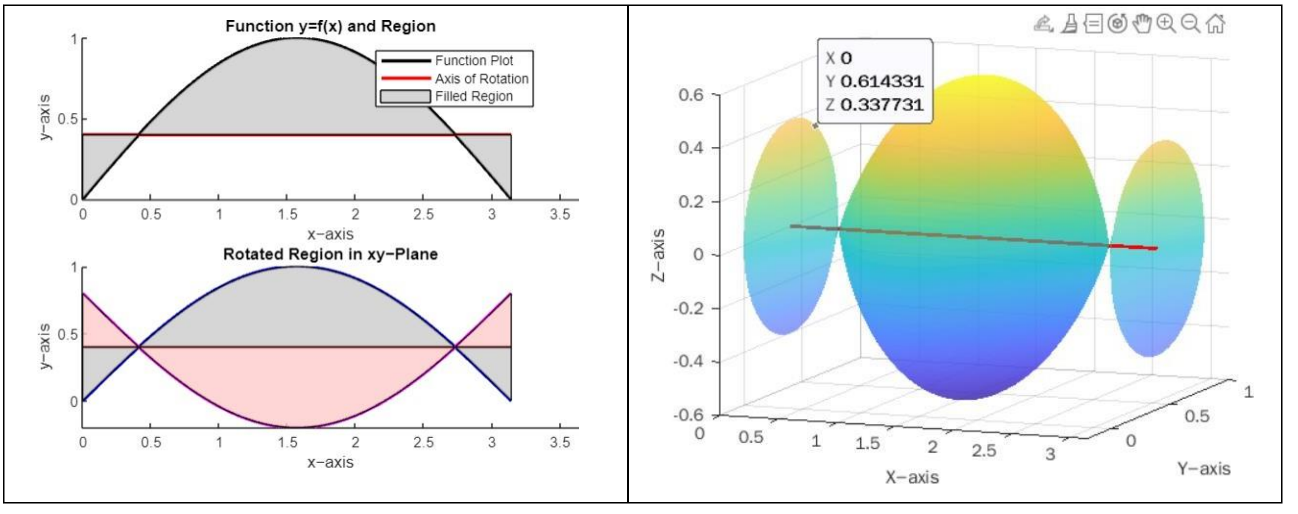
0.4000

iL =

0 3.1416

ans =

'Volume is 1.487391e+00 '



For c=0.6

f

=

s

i

n

(

x

)

f

L

=

0 3.1416

yr =

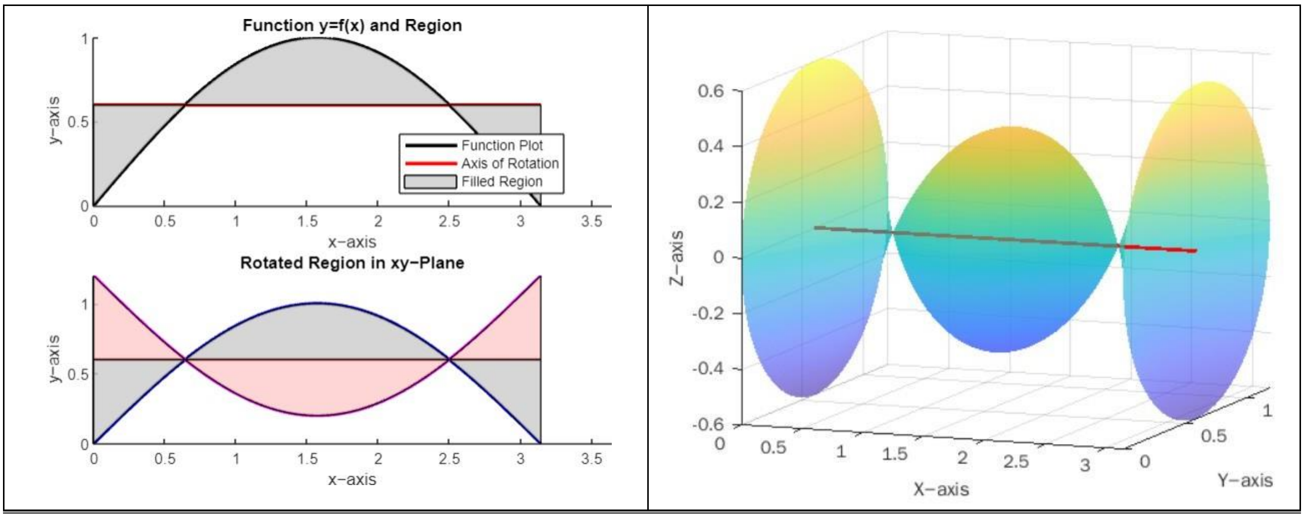
0.6000

iL =

0 3.1416

ans =

'Volume is 9.480374e-01 '



For c=0.8

f

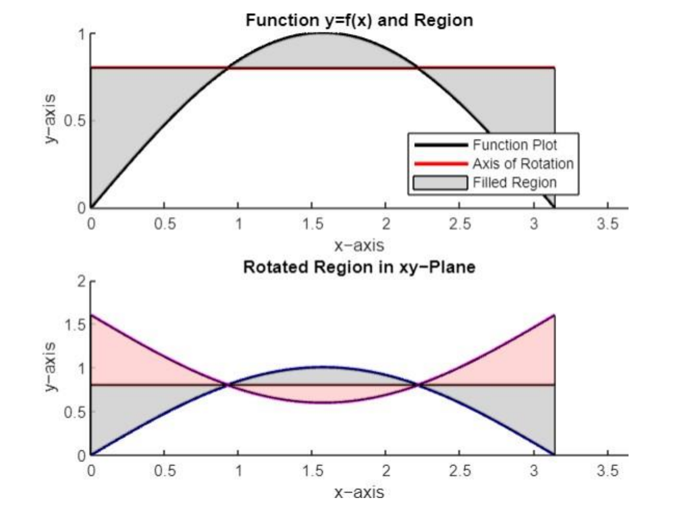
=

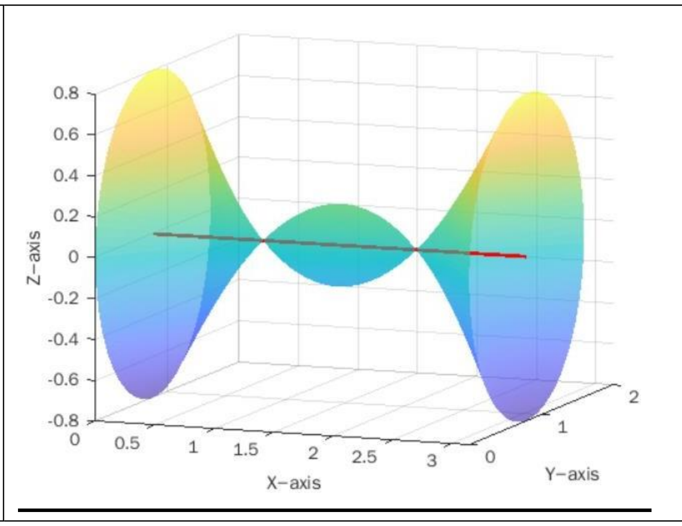
s
i
n
(
x
)

f
L

=
        0   3.1416
yr =
    0.8000
iL =
        0   3.1416

ans =
    'Volume is 1.198253e+00 '


Function y=f(x) and Region
y-axis
x-axis
Function Plot
Axis of Rotation
Filled Region
Rotated Region in xy-Plane
y-axis
x-axis


Z-axis
X-axis
Y-axis