Department of Mathematics

School of Advanced Sciences

MAT 1011 – Calculus for Engineers (MATLAB)

Experiment 2–A

Applications of Integration: finding area, volume of solid of revolution

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Question 1: (Classwork):

Calculate the area bounded by the curves y= 2-x^2 and the line y=-x, from x=-1 to 2 in MATLAB.

Code:

```
clc
clear
close all
syms x
%given functions of the curves and intervals
f(x)=2-x^2;
g(x)=-x;

Interval=[-1,2];
a=Interval(1);
b=Interval(2);

%calculating the area enclosed
Area_enclosed=int(f(x)-g(x),a,b);
disp('The area bounded between the curves f(x) and g(x) is:');
disp(Area_enclosed);

%plotting the curve in a cartesian plane
fplot(f(x),[a,b])
grid on
hold on
fplot(g(x),[a,b])
hold off
xlabel('x-axis')
ylabel('y-axis')
legend ('y=f(x)','y=g(x)')
```

```
clc
clear
close all
syms x
%given functions of the curves and intervals
f(x)=2-x^2;
g(x)=-x;

Interval=[-1,2];
a=Interval(1);
b=Interval(2);

%calculating the area enclosed
Area_enclosed=int(f(x)-g(x),a,b);
disp('The area bounded between the curves f(x) and g(x) is:');
disp(Area_enclosed);

%plotting the curve in a cartesian plane
fplot(f(x),[a,b])
grid on
hold on
fplot(g(x),[a,b])
hold off
xlabel('x-axis')
ylabel('y-axis')
legend ('y=f(x)','y=g(x)')
```

```
The area bounded between the curves f(x) and g(x) is:
9/2

>>
```

COMMAND WINDOW

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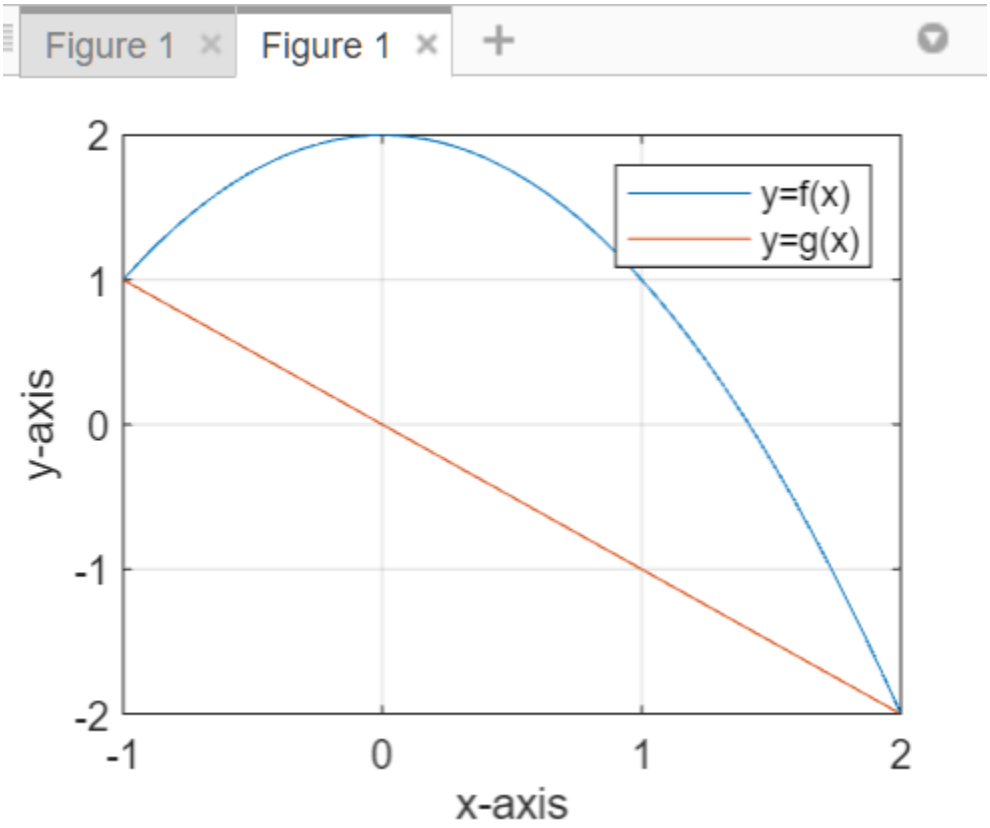


Question 2: (Classwork)

Calculate the volume of solid generated by revolving the curve y= $\sqrt{x}$ about the line y=1 from x=1 to x=4.

Code:

```
clear
clc
close all
syms x

f(x)=sqrt(x); % Given function
yr=1; % Axis of revolution y=yr
I=[0,4]; % Interval of integration
a=I(1);b=I(2);
vol=pi*int((f(x)-yr)^2,a,b);
disp('Volume of the solid of revolution is: ');
disp(vol);

% Visualization of the solid of revolution
fx=matlabFunction(f);
xv = linspace(a,b,101); % Creates 101 points from a to b
[X,Y,Z] = cylinder(fx(xv)-yr);
Z = a+Z.*(b-a); % Extending the default unit height of the cylinder profile to the
interval of integration.
surf(Z,Y+yr,X) % Plotting the solid of revolution about y=yr
hold on;
plot([a b],[yr yr],'-r','LineWidth',2); % Plotting the line y=yr
view(22,11); % 3-D graph viewpoint specification
xlabel('X-axis');
ylabel('Y-axis');
zlabel('Z-axis');
```

```
clear
clc
close all
syms x

f(x)=sqrt(x); % Given function
yr=1; % Axis of revolution y=yr
I=[0,4]; % Interval of integration
a=I(1);b=I(2);
vol=pi*int((f(x)-yr)^2,a,b);
disp('Volume of the solid of revolution is: ');
disp(vol);

% Visualization of the solid of revolution
fx=matlabFunction(f);
xv = linspace(a,b,101); % Creates 101 points from a to b
[X,Y,Z] = cylinder(fx(xv)-yr);
Z = a+Z.*(b-a); % Extending the default unit height of the cylinder profile to the interval of integration.
surf(Z,Y+yr,X) % Plotting the solid of revolution about y=yr
hold on;
plot([a b],[yr yr],'-r','LineWidth',2); % Plotting the line y=yr
view(22,11); % 3-D graph viewpoint specification
xlabel('X-axis');
ylabel('Y-axis');
zlabel('Z-axis');
```

```
Volume of the solid of revolution is:
(4*pi)/3


>>
```

COMMAND WINDOW

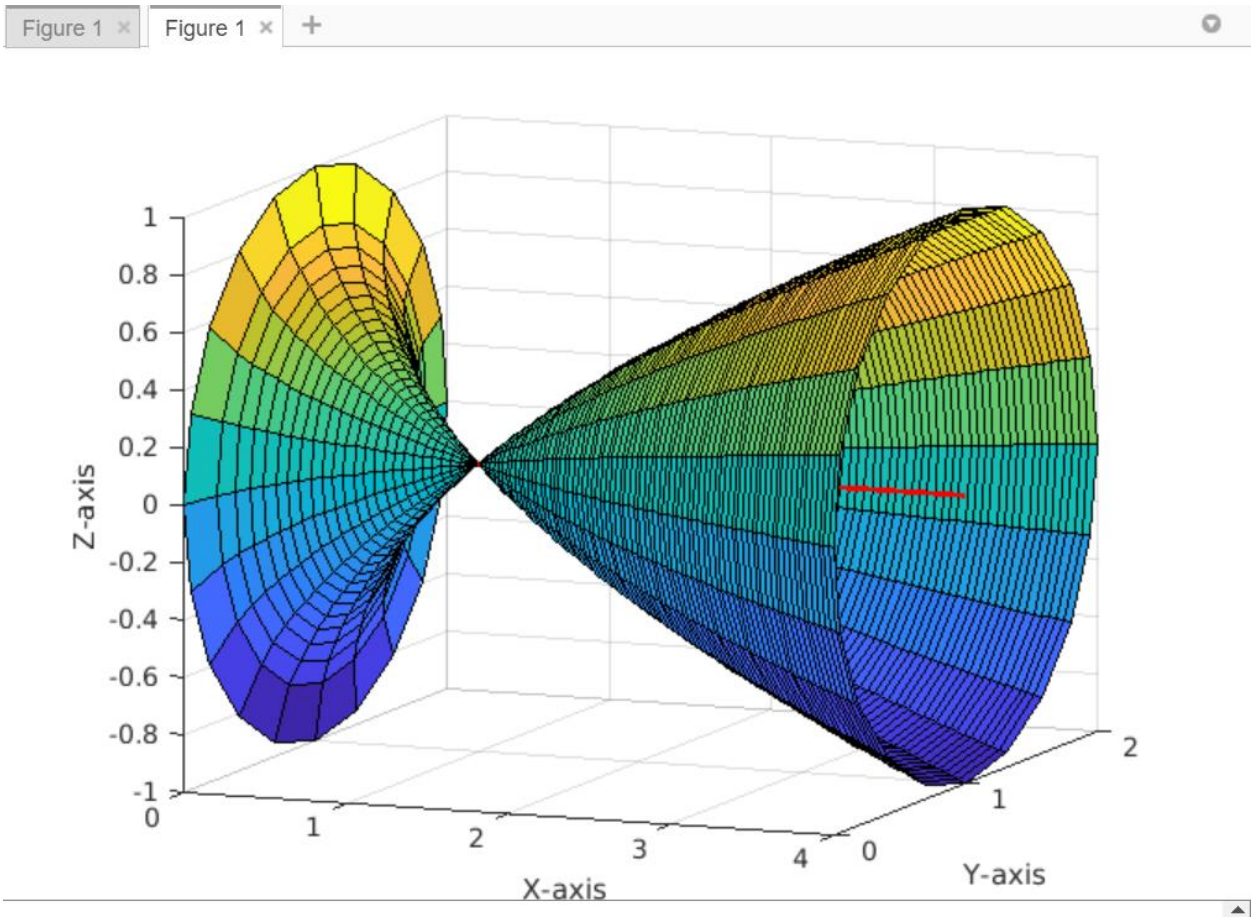


Figure 1
Figure 1
Z-axis
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
1
2
3
4
X-axis
0
1
2
Y-axis

Exercise Question 1:

Find the area of the region bounded by the curve y =x^2-2x and the line y = x.

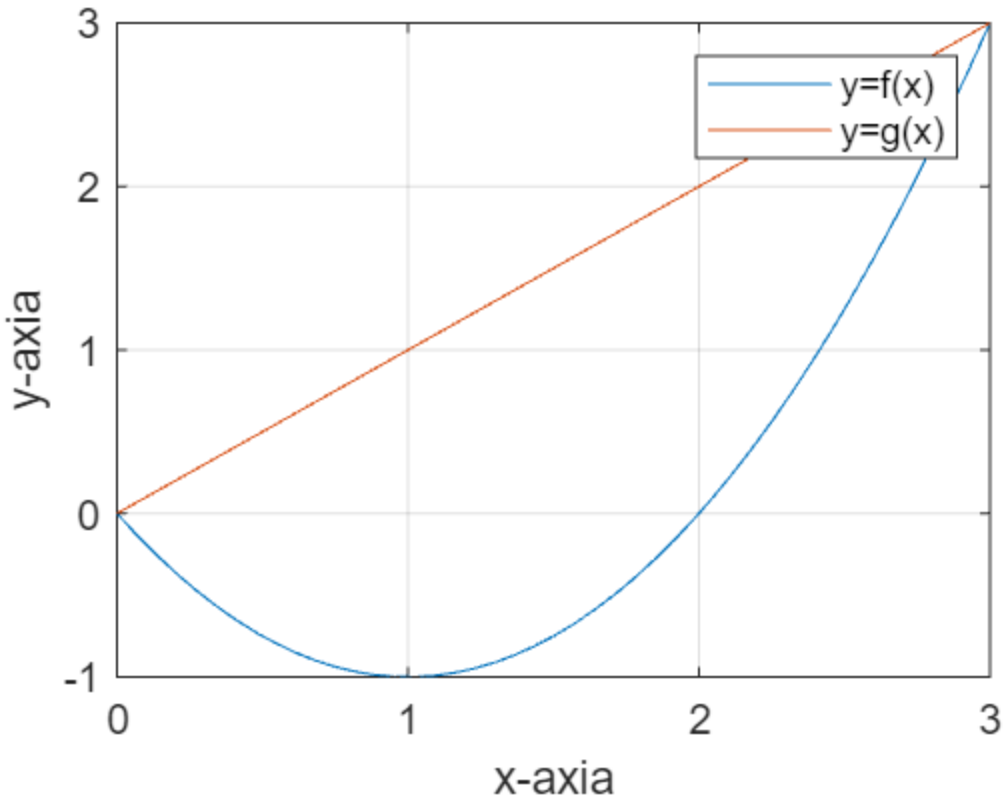
Codes:

```
clc
clear
close all
syms x
%the given functions are:
g(x)=x;
f(x)=x^2-2*x;
Interval=[0,3];
a=Interval(1);
b=Interval(2);

%calculate and display the area
Area_enclosed=int(g(x)-f(x),a,b);
disp('the area enclosed by the curves is:')
disp(Area_enclosed)


%plotting the curves on cartesian plane.
fplot(f(x),[a,b])
grid on
hold on
fplot(g(x),[a,b])
hold off
xlabel('x-axia')
ylabel('y-axia')
legend('y=f(x)','y=g(x)')
```

```
clc
clear
close all
syms x
%the given functions are:
g(x)=x;
f(x)=x^2-2*x;
Interval=[0,3];
a=Interval(1);
b=Interval(2);

%calculate and display the area
Area_enclosed=int(g(x)-f(x),a,b);
disp('the area enclosed by the curves is:')
disp(Area_enclosed)


%plotting the curves on cartesian plane.
fplot(f(x),[a,b])
grid on
hold on
fplot(g(x),[a,b])
hold off
xlabel('x-axia')
ylabel('y-axia')
legend('y=f(x)','y=g(x)')
```

```
the area enclosed by the curves is:
9/2

>>
```

COMMAND WINDOW



Exercise Question 1:

To find the area of the region bounded by the curves $x = y^2$, $y = x - 2$ in the first quadrant.

Codes:

```
clc
clear
close all
syms x

%the given functions and the intervals of their intersections.
f(x)=sqrt(x);
g(x)=x-2;
interval=[0,2,4];

a=interval(1);
b=interval(2);
c=interval(3);

%calculating the area enclosed by two steps integration and summing up.
t = int(f(x),a,b);
u = int(f(x)-g(x),b,c);
total_area = t + u;

disp('The area in the first quadrant encclosed by the curves is')
disp(total_area)

%plotting the curves in cartesian plane.
fplot(f(x),[a,c])
hold on
grid on
fplot(g(x),[b,c])
hold off
xlabel('x-axis')
ylabel('y-axis')
legend('y=f(x)','y=g(x)')
title('Calculating the area enclosed by two curves in the first quadrant')
```

```
clc
clear
close all
syms x

%the given functions and the intervals of their intersections.
f(x)=sqrt(x);
g(x)=x-2;
interval=[0,2,4];

a=interval(1);
b=interval(2);
c=interval(3);

%calculating the area enclosed by two steps integration and summing up.
t = int(f(x),a,b);
u = int(f(x)-g(x),b,c);
total_area = t + u;

disp('The area in the first quadrant encclosed by the curves is')
disp(total_area)

%plotting the curves in cartesian plane.
fplot(f(x),[a,c])
hold on
grid on
fplot(g(x),[b,c])
hold off
xlabel('x-axis')
ylabel('y-axis')
legend('y=f(x)','y=g(x)')
title('Calculating the area enclosed by two curves in the first quadrant')
```

```
The area in the first quadrant encclosed by the curves is
10/3


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```

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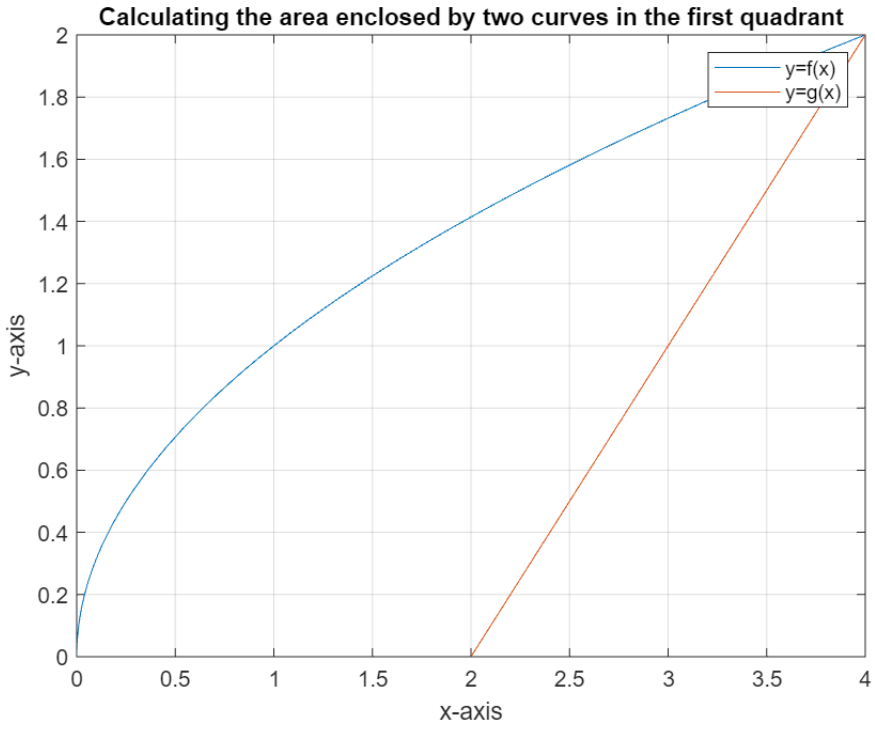
Figure 1


Calculating the area enclosed by two curves in the first quadrant
y=f(x)
y=g(x)
y-axis
x-axis
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
0.5
1
1.5
2
2.5
3
3.5
4

Exercise Question 3:

Find the area of the region bounded by the curves $x = y^3$ and $x = y^2$.

Codes:

```
clc
clear
close all
syms x

f(x)=x^(1/3);

g(x)=x^(1/2);

interval=[0,1];
a=interval(1);
b=interval(2);

area=int(f(x)-g(x),a,b);
disp('The area enclosed by the given curves is')
disp(area)

fplot(f(x),[a,b])
hold on
grid on

fplot(g(x),[a,b])
hold off

xlabel('x-axis')
ylabel('y-axis')
legend('f(x)','g(x)')
title("Calculating the area enclosed by these two curves")
```

```
clc
clear
close all
syms x

f(x)=x^(1/3);

g(x)=x^(1/2);

interval=[0,1];
a=interval(1);
b=interval(2);

area=int(f(x)-g(x),a,b);
disp('The area enclosed by the given curves is')
disp(area)

fplot(f(x),[a,b])
hold on
grid on

fplot(g(x),[a,b])
hold off

xlabel('x-axis')
ylabel('y-axis')
legend('f(x)','g(x)')
title("Calculating the area enclosed by these two curves")
```

Command Window

```
The area enclosed by the given curves is
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>>
```

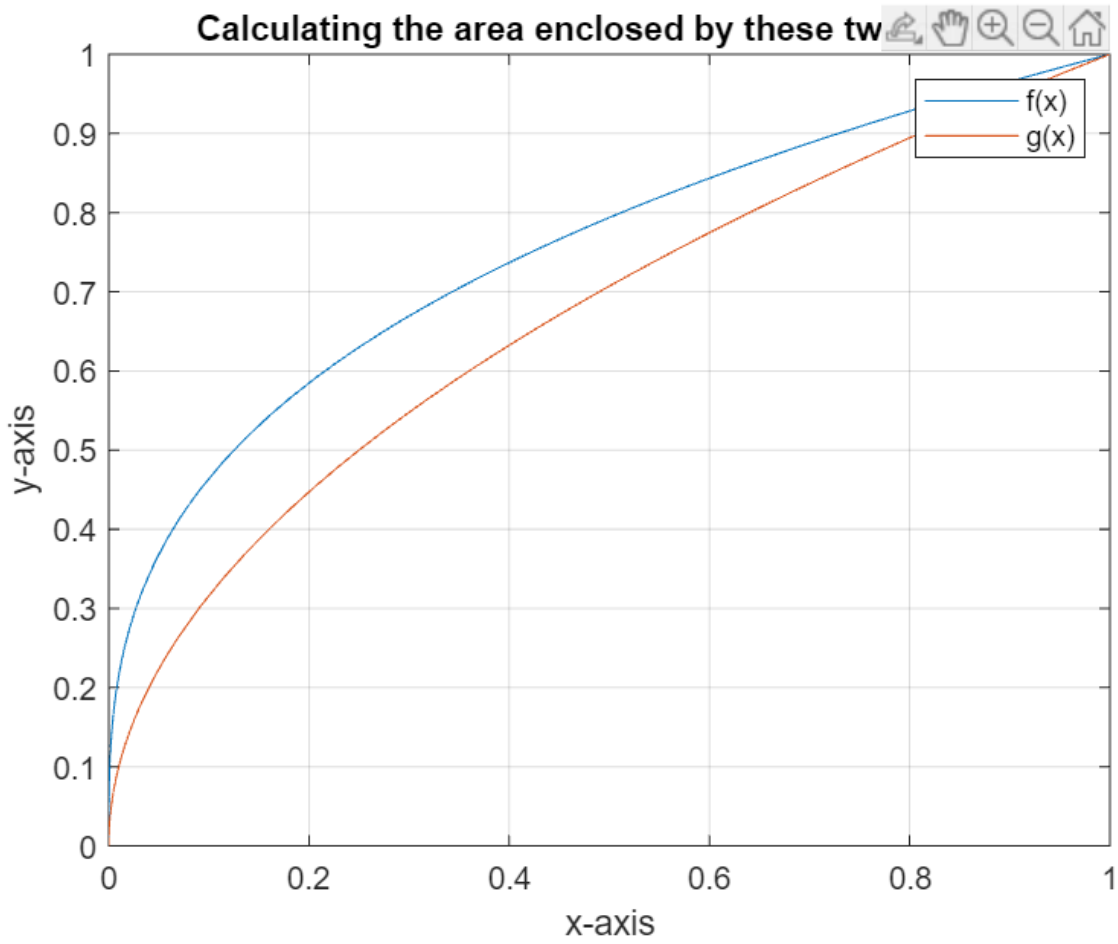
Calculating the area enclosed by these tw
f(x)
g(x)
y-axis
x-axis
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1

Exercise question 4:

Find the volume of the solid generated by revolving about the x – axis the region bounded by the curve y= $\frac{4}{x^2+4}$, the x – axis, and the lines x = 0 and x = 2 .

Codes:

```
clc
clear
close all
syms x
%given function
f(x)=4/(x^2+4);
interval=[0,2];
a=interval(1);
b=interval(2);

%calculating the
volume=int(pi*(f(x)-0)^2,a,b);
disp("The volume of the solid of revolution is:")
disp(volume)


%%plotting the curve in 3d-space
fx=matlabFunction(f);
xv = linspace(a,b,101); % Creates 101 points from a to b
[X,Y,Z] = cylinder(fx(xv)-0);
Z = a+Z.*(b-a); % Extending the default unit height of the
%cylinder profile to the interval of integration.
surf(Z,Y+0,X) % Plotting the solid of revolution about y=yr
hold on;
plot([a b],[0 0],'-r','LineWidth',2); % Plotting the line y=yr
view(22,11); % 3-D graph viewpoint specification
xlabel('X-axis');
ylabel('Y-axis');
zlabel('Z-axis');
```

```
clc
clear
close all
syms x
%given function
f(x)=4/(x^2+4);
interval=[0,2];
a=interval(1);
b=interval(2);

%calculating the
volume=int(pi*(f(x)-0)^2,a,b);
disp("The volume of the solid of revolution is:")
disp(volume)


%%plotting the curve in 3d-space
fx=matlabFunction(f);
xv = linspace(a,b,101); % Creates 101 points from a to b
[X,Y,Z] = cylinder(fx(xv)-0);
Z = a+Z.*(b-a); % Extending the default unit height of the
%cylinder profile to the interval of integration.
surf(Z,Y+0,X) % Plotting the solid of revolution about y=yr
hold on;
plot([a b],[0 0],'-r','LineWidth',2); % Plotting the line y=yr
view(22,11); % 3-D graph viewpoint specification
xlabel('X-axis');
ylabel('Y-axis');
zlabel('Z-axis');
```

Command Window

```
The volume of the solid of revolution is:
(pi*(pi + 2))/4


>>
```

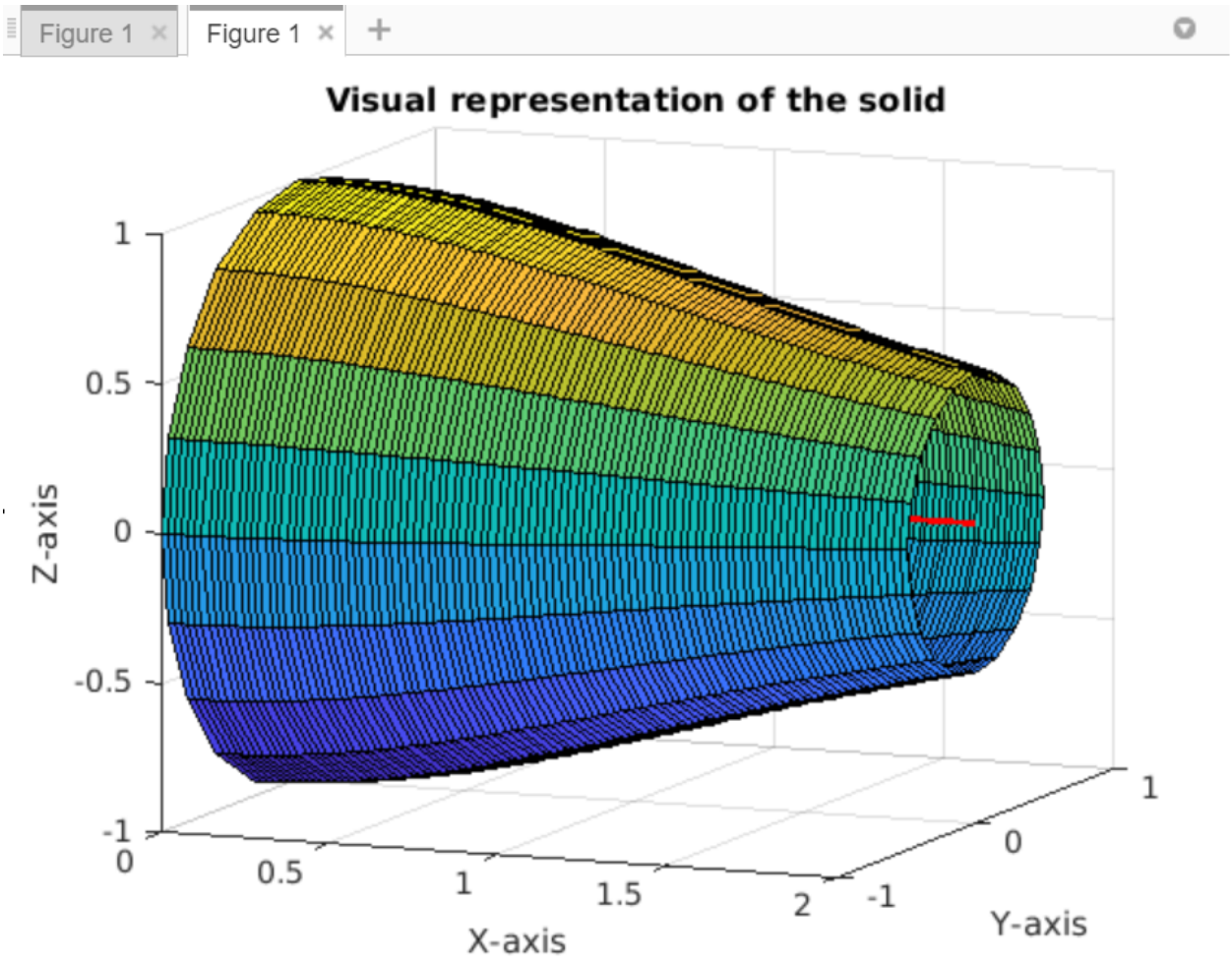
Figure 1
Figure 1
Visual representation of the solid
Z-axis
X-axis
Y-axis
1
0.5
0
-0.5
-1
0
0.5
1
1.5
2
-1
0
1