

Volume of the Solid of Revolution (Week 4)

First we defined the symbolic variables

```
clc
clear all
syms x
```

We will take input the function f , limits on which the function is defined, line $y = c$ axis of rotation and limits of integration.

```
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: ');
```

We next find the volume of the 3D surface generated by rotating the function $f(x)$ around the line $y = c$

```
Volume = pi*int((f - yr)^2,iL(1),iL(2));
disp(['Volume is: ', num2str(double(Volume))])
```

We now plot the function $f(x)$ and the line $y = c$, defining the axis of rotation and the area bounded by these curves. In another figure, we plot the rotated region of $f(x)$ in the given integration limits. For this first we convert the given symbolic function f into a MATLAB function by using the inline command of MATLAB. Next we define the x and y ranges on which we have to plot the regions. For plotting the regions using the fill command, we have to flip the range of values of x . For this we use the in built MATLAB command `fliplr`.

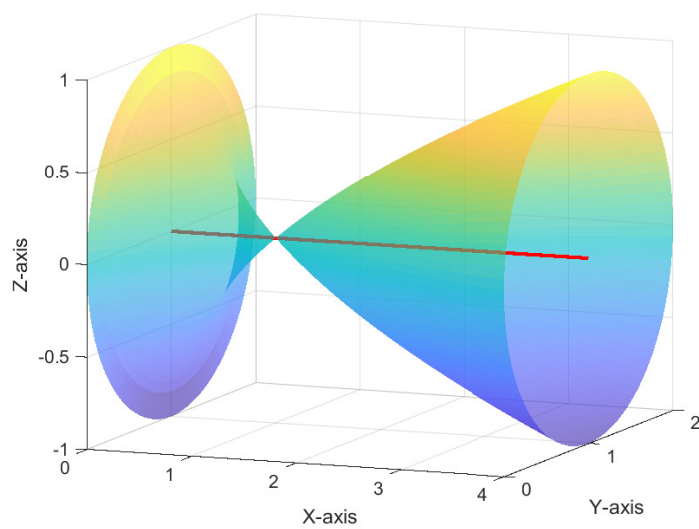
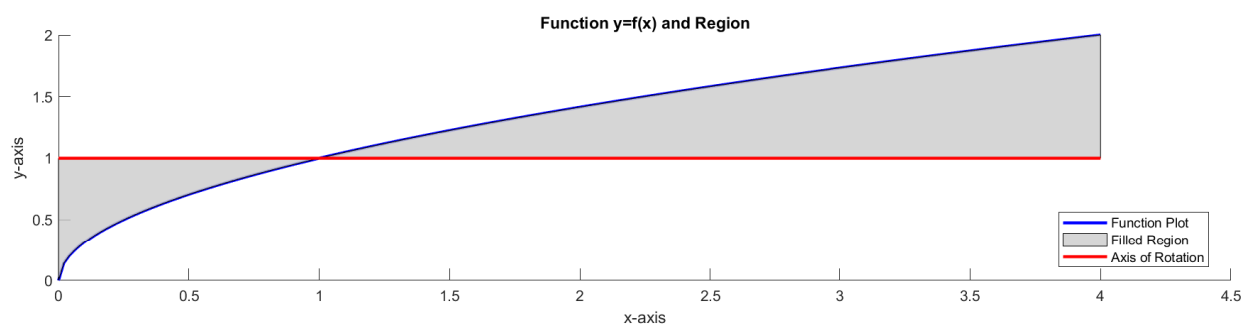
```
fx = inline(vectorize(f));
xvals = linspace(fL(1),fL(2),201);
xvalsr = fliplr(xvals);
xivals = linspace(iL(1),iL(2),201);
xivalsr = fliplr(xivals);
xlim = [fL(1) fL(2)+0.5];
ylim = fx(xlim);
```

After defining the necessary variables, we will plot the function $f(x)$ in the given function limits.

```
figure('Position',[100 200 560 420])
subplot(2,1,1)
hold on;
plot(xvals,fx(xvals),'-b','LineWidth',2);
```

Finally, we generate the solid of revolution using the MATLAB command `cylinder` and visualize it using the `surf` command. We also plot the line, representing the axis of rotation.

```
[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(22,11);
```



Practice Problems

- (1) Visualize and find the volume of the region in the first quadrant bounded above by the line $y = \sqrt{2}$ below by the curve $y = \sec(x) \tan(x)$, and on the left by the y axis, about the line $y = \sqrt{2}$.
- (2) Visualize and find the volume of the solid generated by revolving the region bounded by curve $y = \sin(x)$, $0 \leq x \leq \pi$ about the line $y = 0.5$.