

**Islamic University of Technology (IUT)**  
Organization of Islamic Cooperation (OIC)  
Department of Electrical and Electronic Engineering (EEE)

**COURSE NO** : **EEE 4416**  
**LAB NO** : **09 (Part – B)**  
**TOPIC** : **3D Plots in MATLAB**

## 3D Plots in MATLAB

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### Objective

- Introduction to 3D plotting functions in MATLAB.
- Visualize mathematical functions using various 3D plot types.
- Familiarization with basic 3D plot customization.

3D plots in MATLAB are useful for visualizing data involving three variables (x, y, z). MATLAB offers several types of 3D plots, including line plots, surface plots, mesh plots, contour plots, and vector field plots.

## Common 3D Plot Types in MATLAB

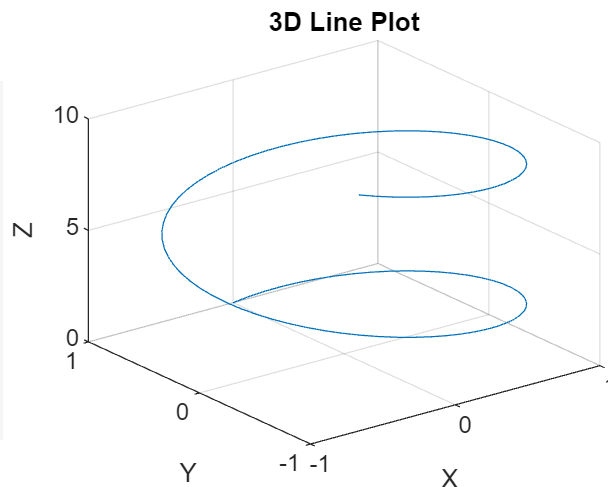
### 3D Line Plot

A 3D line plot connects points in three-dimensional space to visualize a path or trend.

**Syntax:** `plot3(X, Y, Z)`

#### Example:

```
t = 0:0.1:10;  
x = sin(t);  
y = cos(t);  
z = t;  
plot3(x, y, z)  
xlabel('X');  
ylabel('Y');  
zlabel('Z');  
title('3D Line Plot');  
grid on;
```



## Surface Plot:

A surface plot is used to visualize a 3D surface. It is typically used to visualize functions of two variables.

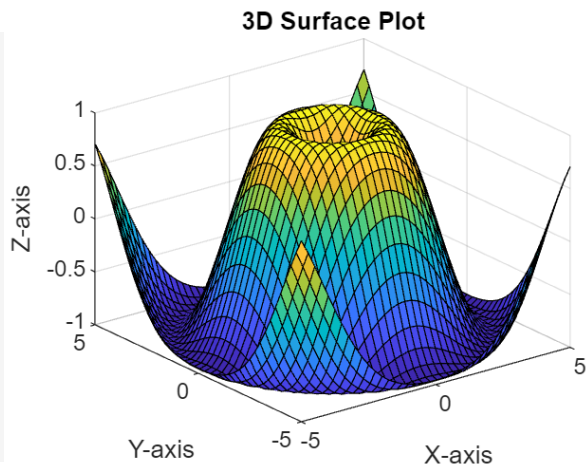
**Syntax:** surf(X, Y, Z)

**Example:**

```
[X, Y] = meshgrid(-5:0.25:5, -5:0.25:5);
Z = sin(sqrt(X.^2 + Y.^2));

% Surface plot
figure

surf(X, Y, Z)
title('3D Surface Plot')
xlabel('X-axis')
ylabel('Y-axis')
zlabel('Z-axis')
```



This will create a 3D surface plot of the function  $Z = \sin(\sqrt{x^2 + y^2})$ , displaying a smooth surface.

## Mesh Plot:

A mesh plot is like a surface plot but displays the grid lines as a wireframe instead of a solid surface.

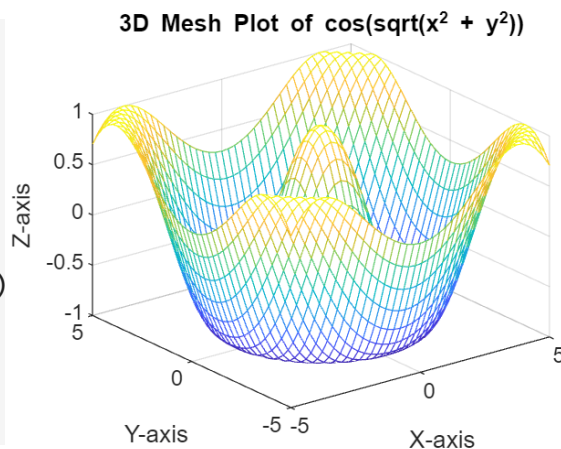
**Syntax:** mesh(X, Y, Z)

**Example:**

```
[X, Y] = meshgrid(-5:0.25:5, -5:0.25:5);
Z = cos(sqrt(X.^2 + Y.^2));

% Mesh plot
figure
mesh(X, Y, Z)
title('3D Mesh Plot of cos(sqrt(x^2 + y^2))')

xlabel('X-axis')
ylabel('Y-axis')
zlabel('Z-axis')
```



This creates a wireframe mesh plot showing the function  $Z = \cos(\sqrt{x^2 + y^2})$ .

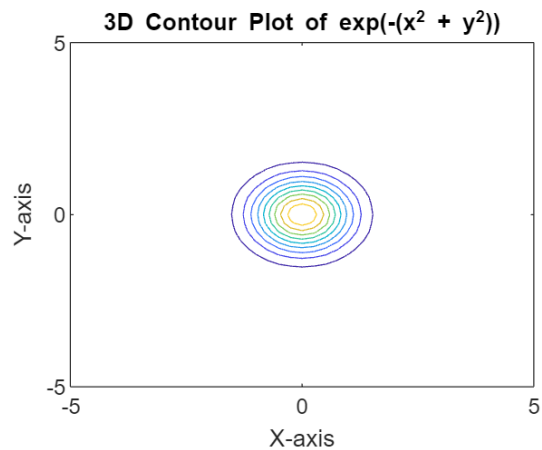
## Contour Plot:

Contour plots represent 3D data in two dimensions, where contour lines represent levels of constant  $Z$ .

**Syntax:** `contour(X, Y, Z)`

**Example:**

```
[X, Y] = meshgrid(-5:0.25:5, -5:0.25:5);  
Z = exp(-(X.^2 + Y.^2));  
  
% Contour plot  
figure  
contour(X, Y, Z)  
title('3D Contour Plot of exp(-(x^2 + y^2))')  
xlabel('X-axis')  
ylabel('Y-axis')
```



This will create contour lines representing the exponential decay function  $Z = \exp(-(x^2 + y^2))$

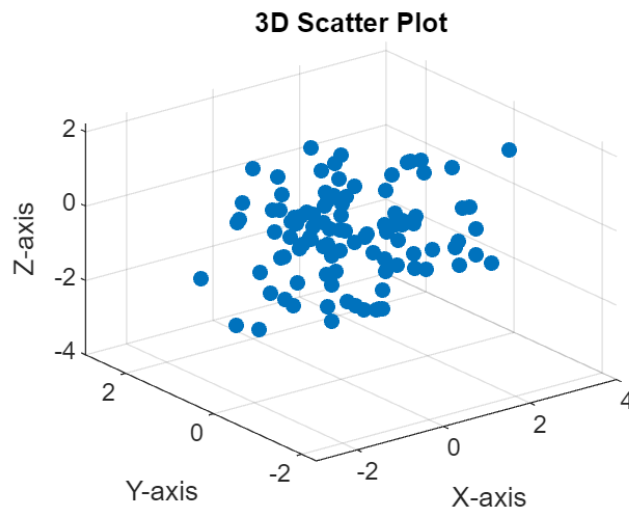
## 3D Scatter Plot:

A 3D scatter plot is used to display data points in three-dimensional space. It's useful for visualizing the relationship between three variables

**Syntax:** `scatter3(X, Y, Z)`

**Example:**

```
X = randn(1, 100);  
Y = randn(1, 100);  
Z = randn(1, 100);  
  
% 3D scatter plot  
figure  
scatter3(X, Y, Z, 'filled')  
title('3D Scatter Plot')  
xlabel('X-axis')  
ylabel('Y-axis')  
zlabel('Z-axis')
```



This will display a set of 100 random points in 3D space.

## Customizing Plots:

We can customize our 3D plots in MATLAB by adding various features such as:

- Title, labels, and grid
- Color maps for better visualization
- Lighting for better appearance

### Example:

```
% Create surface plot
[X, Y] = meshgrid(-5:0.25:5, -5:0.25:5);
Z = sin(sqrt(X.^2 + Y.^2));

% Plot with lighting and custom colormap
figure
surf(X, Y, Z)
title('3D Surface Plot with Lighting and Custom Colormap')
xlabel('X-axis')
ylabel('Y-axis')
zlabel('Z-axis')
colormap('winter')
shading faceted
light
lighting gouraud
```

