

## MATH.2720 Introduction to Programming with MATLAB 3D Graphics

### A. Plotting Curves in 3D

The command `plot3` is the 3D analog of the command `plot` for plotting curves. Here is an example, taken from Section 10.1 of the textbook.

```
t=0:0.1:6*pi;
x=sqrt(t).*sin(2*t);
y=sqrt(t).*cos(2*t);
z=0.5*t;
plot3(x,y,z,'k')
grid on
xlabel('x'); ylabel('y'); zlabel('z')
```

Try running these commands without using `grid on` to see what the difference is. If you click on the toolbar icon to the right of the hand, you can rotate the graph and view it from different angles.

### B. Plotting Graphs of Functions of Two Variables

The commands `surf` and `mesh` can be used to generate a graph of a function of two variables, which will be a surface. Here is an example from section 10.2 of the textbook.

```
x=-3:0.25:3;
y=-3:0.25:3;
[X,Y] = meshgrid(x,y);
Z=1.8.^(-1.5*sqrt(X.^2+Y.^2)).*cos(0.5*Y).*sin(X);
surf(X,Y,Z)
xlabel('x'); ylabel('y'); zlabel('z')
```

Try the command `mesh(X, Y, Z)` to see what it does. To add contour lines to your graph, use the command `surf(X, Y, Z)` or `meshc(X, Y, Z)`

### C. Plotting Surfaces Described Parametrically

Here is an example displaying the graph of the surface described parametrically by the equations  $x = \sin(\phi) \cos(\theta)$ ,  $y = \sin(\phi) \sin(\theta)$ ,  $z = \cos(\phi)$  for  $0 \leq \theta \leq \pi$ ,  $0 \leq \phi \leq \pi/2$ .

```
theta=linspace(0,pi,20);
phi=linspace(0,pi/2,20)'; % Don't forget the '
x=sin(phi)*cos(theta);
y=sin(phi)*sin(theta);
z=cos(phi)*ones(size(theta));
surf(x,y,z)
```

### D. Practice Problems

1. Plot the curve given by the parametric equations  $x = \cos(2t)$ ,  $y = \sin(2t)$ ,  $z = \cos(3t)$  for  $0 \leq t \leq 6\pi$ .
2. Graph the surface given by  $z = 4 - x^2 - y^2$  for  $-1 \leq x \leq 1$ ,  $-1 \leq y \leq 1$ .