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.

```
t=linspace(0, 6*pi, 500);
x=t.*cos(2*t);
y=t.*sin(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 left click on the graph and move the mouse, 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 generated a graph of a function of two variables, which will be a surface. Here is an example.

```
xArray = linspace(-1, 1, 50);
yArray = xArray;
[x, y] = meshgrid(xArray, yArray);
z = sin(2*pi*x.*y); %Use x.*y, not x*y
surf(x, y, z)
```

Try the command `mesh(x, y, z)` to see what it does. To add contour lines to your graph, use the command `surfc(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 $0 \le \theta \le \pi,\ 0 \le \phi \le \pi/2$.

```
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 $0 \le t \le 6\pi$.
2. Graph the surface given by $z = 4 - x^2 - y^2$ for $-2 \le x \le 2,\ -2 \le y \le 2$.