MATH 333
Lab02SpaceCurves

Objective
The objective of this project is to illustrate some of the geometry of curves in space using *Mathematica*.

Narrative
If you have not already done so, read Section 13.1 in the text.
In this project we use the command **ParametricPlot3D**. This command allows us to plot the graph of a parametrized space curve. Also, we illustrate how we can visualize curves in space as intersections of planes and other surfaces.

Task
a) Type the command lines below into *Mathematica* in the order in which they are listed. They illustrate a trefoil knot, and a thicker version of this knot (which gives a better idea of the knots geometry). Note that to move to a new line (carrage return) in *Mathematica* without exicuting the command, use the regular <enter> key and to execute a command use the number-pad <enter> key.

```
(* A Trefoil knot *)

ParametricPlot3D[
  {(2 + Cos[1.5*t])*Cos[t],(2 + Cos[1.5*t])*Sin[t], 2*Sin[1.5*t]},
  {t, 0, 4*Pi}, PlotStyle -> Blue, PlotPoints -> 100]

ParametricPlot3D[
  {(2 + Cos[1.5*t])*Cos[t],(2 + Cos[1.5*t])*Sin[t], 2*Sin[1.5*t]},
  {t, 0, 4*Pi}, PlotStyle -> Directive[Thickness[.02], Blue],
  PlotPoints -> 100]
```

b) Continue by typing the command lines below into *Mathematica* in the order in which they are listed. They illustrate a helix, and a right circular cylinder and a sinusoidal cylinder whose intersection is the helix.

```
(* A helix *)
plot0 = ParametricPlot3D[{Cos[t], Sin[t], 0.5*t}, {t, 0, 3*Pi},
  PlotStyle -> Directive[Thickness[.02], Red]]

plot1 = ContourPlot3D[ x^2 + y^2 == 1, {x, -1.5, 1.5}, {y, -1.5, 1.5},
 {z, 0, 1.5*Pi}, ContourStyle -> Directive[Green, Opacity[.8]],
 Mesh -> None]

plot2 = ContourPlot3D[ x == Cos[2*z], {x, -1.5, 1.5}, {y, -1.5, 1.5},
  {z, 0, 1.5*Pi}, ContourStyle -> Directive[Blue, Opacity[0.8]],
  Mesh -> None]

Show[plot0, plot1, plot2, BoxRatios -> {1, 1, 1}]
```

At this point, make a hard-copy of your typed input and *Mathematica's* responses. Then, ...

c) On the last graphic you created in part (b), label (by hand) the positive x-, y-, and z-coordinate directions. Label the right circular cylinder and the sinusoidal cylinder with their equations. Finally, highlight (by hand) the helix. Your lab report will be a hard copy of your typed input and *Mathematica's* responses.

Comments
Some other curves you might enjoy looking at include:
1. the toroidal curve: $\langle (4+\sin(20t))\cos(t), (4+\sin(20t))\sin(t), \cos(20t)\rangle$ where $t \in [0, 2\pi]$,
2. the twisted cubic: $\langle t, t^2, t^3\rangle$ where $t \in [-2, 2]$,
3. the curve: $\langle \sin(t), \sin(2t), \sin(3t)\rangle$ where $t \in [0, 2\pi]$.
For the toroidal curve you might want to use the option numpoints=200 to produce a smooth curve.