MATH 261, Spring 2001 **Due Date:**____________ **Name(s):** ________________________

Project 14.1c: Curves in Space

Objective

The objective of this project is to illustrate some of the geometry of curves in space.

Narrative

If you have not already done so, read Section 14.1 in the text.

In this project we introduce the command `spacecurve` in Maple's `plots` package. 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 Maple in the order in which they are listed.

```
> # Project 14.1c:  Curves In Space
> restart:  with(plots):
> setoptions3d(scaling=constrained,orientation=[30,80],axes=normal):
```

b) Continue by typing the command lines below into Maple in the order in which they are listed. They illustrate a trefoil knot, and a "tubular" version of this knot (which gives a better idea of the knot's geometry.)

```
> # A trefoil knot
> spacecurve([(2+cos(1.5*t))*cos(t),(2+cos(1.5*t))*sin(t),2*sin(1.5*t)],t=0..4*Pi,
    color=blue,numpoints=100);
> tubeplot([(2+cos(1.5*t))*cos(t),(2+cos(1.5*t))*sin(t),2*sin(1.5*t)],t=0..4*Pi,
    radius=0.25,numpoints=100);
```

c) Continue by typing the command lines below into Maple 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 := spacecurve([cos(t),sin(t),0.5*t],t=0..3*Pi,shading=none,color=red,
      thickness=2):
> display(plot0);
> plot1 := implicitplot3d(x^2+y^2=1,x=-1.5..1.5,y=-1.5..1.5,z=0..1.5*Pi,
      shading=none,color=green):
> display({plot0,plot1});
> plot2 := implicitplot3d(x = cos(2*z),x=-1.5..1.5,y=-1.5..1.5,z=0..1.5*Pi,
      shading=none,color=blue,grid=[10,10,20]):
> display({plot0,plot2});
> display({plot0,plot1,plot2});
```

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

d) On the last graphic you created in part (c), label (by hand) the positive x-, y-, and z-coordinate axes, and 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 Maple's responses.

Comments

Some other curves you might enjoy looking at include:

1. the toroidal curve: `[(4+sin(20*t))*cos(t),(4+sin(20*t))*sin(t),cos(20*t)]` where $t \in [0, 2\pi]$,
2. the twisted cubic: `[t,t^2,t^3]` where $t \in [-2, 2]$,
3. the curve: `[sin(t),sin(2*t),sin(3*t)]` where $t \in [0, 2\pi]$.

For the toroidal curve you might want to use the option `numpoints=200` to produce a smooth curve.