COMPUTER #2 – MATH 1260, FALL 2014

DUE FRIDAY OCTOBER 3RD

Two ants are exploring the surface of a doughnut. This doughnut was obtained by rotating the circle $(x-4)^2+z^2=4$ around the z axis.

In the end I expect each pair of students to *type* a 1.5-4 page paper explaining what you have done. If you answer everything perfectly, you can get 17/20 points. To get 20 out of 20 points you must do something more, going above and beyond what is expected of you. Be creative (it can involve online research, doing a fantastic write-up, or extending the problem to something even more interesting, use your imagination).

1. First find a parametrization of this doughnut. The best way to do this is to think about any point (x,y,z) on the surface of the doughnut as given by two angles. The first is the angle along the great circle in the center of the doughnut $x^2+y^2=16$, and the second is the angle around the radius two circle around the dough of the doughnut. Use this to parameterize the surface of the doughnut. Once you have parameterized the surface of the doughnut via $\langle f(x,y), g(x,y), h(x,y)\rangle$, you can plot it in Maxima via the command

```
plot3d([f(x,y),g(x,y),h(x,y)],[x,0,2*%pi],[y,0,2*%pi]);
```

You can plot it in Maple with the command

```
plot3d([f(x,y),g(x,y),h(x,y)],x=0..Pi,y=0..Pi);
```

where f,g,h are replaced with the functions you came up with. You should include such plots in your report.

2. The two ants detect frosting and sprinkles at $Q=(3\sqrt{2},3\sqrt{2},0)$. The ants contact the doughnut at location $(\mathbf{0},-\mathbf{4},-\mathbf{2})$. Find what these points correspond to in your parametrization.

3. The first ant suggests first traveling to the outer edge of the doughnut and then walking along until point Q is reached.

The second ant suggests a different path. It suggests walking first to the inner edge, walking along it until the ant is opposite Q, and then walking over the top until Q is reached.

Find parameterizations of both paths. Find the arclength of each of the path. Which path is better? You can plot a path $t\mapsto\langle f(t),g(t),h(t)\rangle$ as t goes from 0 to 1 in Maxima via the command

```
plot3d([f(t),g(t),h(t)],[t,0,1],[s,0,1])
```

The `[s,0,1]` is just because maxima thinks it is parameterizing a surface. You can also plot it in Maple via the command

```
with(plots);
spacecurve([f(t),g(t),h(t)],t=0..1);
```

You can parameterize two curves on the same plot $\langle f_1(t),g_1(t),h_1(t)\rangle$ and $\langle f_2(t),g_2(t),h_2(t)\rangle$ via

```
plot3d([[f1(t),g1(t),h1(t)],[t,0,1],[s,0,1],[f2(t),g2(t),h2(t)],[t,0,1],[s,0,1]]);
```

or in Maple via

```
spacecurve({[f1(t),g1(t),h1(t)],[f2(t),g2(t),h2(t)]},[t,0,1]);
```

you might need this since the paths each have at least two parts. Plot these two paths and include them into your report.

4. Compute the arclengths of the two paths (you'll have to consider two pieces). Which path is better? You might find the command

```
integrate(f(t),t,a,b)
```

useful where a and b are the bounds of integration or via Maple with

```
int(f(t),t=a..b)
```

5. Find a better path. (You might find it helpful to consider how these paths look on your parameterization of the doughnut in **1.**). Make sure to plot out your best path. Describe how you came up with it.