

Math 2415
Calculus III
Lab Exercise # 5

Name _____

Date _____

Attach the computer printouts to this sheet.

1. Is there an orientation to either one?
2. Use Maple code located in Eduspace, Chapter Project, maple data.
3. Yes, it is possible. Multiple either one of the x and y equations by a nonzero value. Let me know what value you used and write the equation. DO NOT sketch the torus.

Mathematical Sculpture

Whether mathematics is seen as a science or as an art depends on one's perspective. One mathematician-sculptor, Helaman Ferguson, combines both viewpoints in a unique way. Ferguson's sculptures, which bear such names as *Cosine Wild Sphere* and *Esker Trefoil Torus*, are the concrete embodiments of mathematical concepts that incorporate ideas such as series expansions and vector fields into their creation. Some of the basic images of his work are tori and double tori, Möbius strips, and trefoil knots. One of his techniques is to use three-dimensional computer graphics to model his intended sculptures. The coordinates on the computer screen can then be used to direct the sculpting.

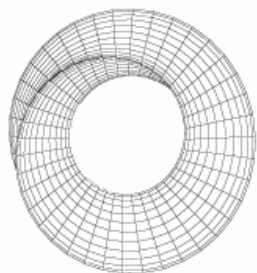
One example of Helaman Ferguson's work, *Umbilic Torus NC*, is shown below. This form can be written as a parametric surface using the following set of parametric equations.

$$x = \sin u \left[7 + \cos\left(\frac{u}{3} - 2v\right) + 2 \cos\left(\frac{u}{3} + v\right) \right]$$

$$y = \cos u \left[7 + \cos\left(\frac{u}{3} - 2v\right) + 2 \cos\left(\frac{u}{3} + v\right) \right]$$

$$z = \sin\left(\frac{u}{3} - 2v\right) + 2 \sin\left(\frac{u}{3} + v\right)$$

$$-\pi \leq u \leq \pi, \quad -\pi \leq v \leq \pi$$



Generated by Mathematica

Mathematica rendition of
Umbilic Torus NC



Photograph of *Umbilic Torus NC*

QUESTIONS

1. Explain how the umbilic torus shown above is similar to a Möbius strip.
2. Use a three-dimensional computer algebra system to graph the torus. You will have to use the *parametric surface* graphing mode.
3. When viewed head-on (along the z -axis), the torus appears nearly circular. Is it possible to alter this appearance so that the shape of the torus is more like that of an elongated ellipse? If so, use a computer algebra system to sketch an "elliptical" torus.

The concepts presented here will be explored further in this chapter. For an extension of this application, select the Calculus Lab button.

Calculus Lab

Mathematical Sculpture

Whether mathematics is seen as a science or as an art depends on one's perspective. One mathematician-sculptor, Helaman Ferguson, combines both viewpoints in a unique way. Ferguson's sculptures, which bear such names as *Cosine Wild Sphere* and *Esker Trefoil Torus*, are the concrete embodiments of mathematical concepts that incorporate ideas such as series expansions and vector fields into their creation. Some of the basic images of his work are tori and double tori, Möbius strips, and trefoil knots. One of his techniques is to use three-dimensional computer graphics to model his intended sculptures. The coordinates on the computer screen can then be used to direct the sculpting.

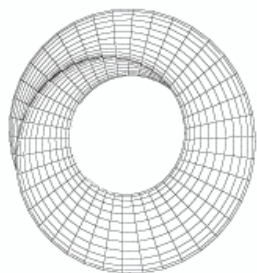
One example of Helaman Ferguson's work, *Umbilic Torus NC*, is shown below. This form can be written as a parametric surface using the following set of parametric equations.

$$x = \sin u \left[7 + \cos\left(\frac{u}{3} - 2v\right) + 2 \cos\left(\frac{u}{3} + v\right) \right]$$

$$y = \cos u \left[7 + \cos\left(\frac{u}{3} - 2v\right) + 2 \cos\left(\frac{u}{3} + v\right) \right]$$

$$z = \sin\left(\frac{u}{3} - 2v\right) + 2 \sin\left(\frac{u}{3} + v\right)$$

$$-\pi \leq u \leq \pi, \quad -\pi \leq v \leq \pi$$



Generated by Mathematica

Mathematica rendition of
Umbilic Torus NC



Photograph of *Umbilic Torus NC*

QUESTIONS

1. Explain how the umbilic torus shown above is similar to a Möbius strip.
2. Use a three-dimensional computer algebra system to graph the torus. You will have to use the *parametric surface* graphing mode.
3. When viewed head-on (along the z -axis), the torus appears nearly circular. Is it possible to alter this appearance so that the shape of the torus is more like that of an elongated ellipse? If so, use a computer algebra system to sketch an "elliptical" torus.

The concepts presented here will be explored further in this chapter. For an extension of this application, select the *Calculus Lab* button.

Calculus Lab

