3D Printing Design Project

Prof. Denne's Math 102

Goals

- Familiarize yourself with the 3D printing process, and design for 3D printing using the software Cinema 4D.
- Design two models for 3D printing from the volumes sections in Calculus II.
- Write about the mathematics and the design process of the models.

The Project

1. Learn to use Cinema 4D.
2. Use Cinema 4D to model a basic volume using the disk method with 6-10 slices. (The model should be sized so that it can be held easily your a hand.)
3. Use Cinema 4D to model a more complex volume using an appropriate number of slices. (The model should be sized so that it can be held easily in your hand.)
4. Create a technical report summarizing your results:
   (a) For each model compute the volume using an integral. You must give a detailed explanation of how you set up the integral in each case.
   (b) For each model explain how you worked out the dimensions of the slices. Write down the mathematics you use, and give a table of values describing the each slice. (The table should include enough information that each slice is completely defined. It may include the center of the disk, the radius, the thickness of the slice, the location of the vertices, etc, etc.)
   (c) For each model describe the choices you made in creating a good 3D-printable model. Did your Cinema4D model differ from the mathematical one in any way?
   (d) Your description will include screen shots of your models from Cinema 4D.

Due dates and grading rubric

Each group will submit three pieces of work.

1. One Cinema 4D file with your first model. **Due 4:30pm Friday November 18, 2016.**
   Label the file clearly with the names of your group members: for example, Name1-Name2-Name3-Model1.c4d. One person from each group will upload this to DropBox on the Sakai site for Math 102.

2. One Cinema 4D file with your second model. **Due 4:30pm Tuesday November 29, 2016.**
   Label the file clearly with the names of your group members: for example, Name1-Name2-Name3-Model2.c4d. One person from each group will upload this to DropBox on the Sakai site for Math 102.

3. One Technical Report of your group's work. **Due 4:30pm Thursday December 1, 2016.**

   - The report must include the names of your group members.
   - The report must be typed and should be 2-4 pages in length (not including figures).
   - Figures can be computer-generated, or (neatly) hand drawn. Calculations may be typed or (neatly) hand written.
   - The report should be written in a clear, concise manner using proper grammar.
   - I expect that you will mostly work within your group. However, please cite any other group which has helped you with your project.
   - The report may be handed in as a printed document, or may be uploaded the the DropBox on the Sakai site for Math 102.

Grades

1. This project will be a part of your HW grade for the course. It will be worth the equivalent of 4 individual HW assignments. (This is roughly 4% of your overall course grade.)

2. The grade will be divided into 5 categories. The first four concern the correctness of your mathematical presentation and explanation. The fifth measures your composition style.

Category	*Worth*
Finding the volumes correctly by integration	10 pts
Explanation of reasoning for integrals	10 pts
Correct Cinema 4D models	30 pts
Explanation of how C4D models were created	30 pts
Style and Grammar	20 pts
Total	*100 pts*

Volumes to model

Model A

A1 The volume is created by rotating the area under the parabola $y = 4 - x^2$ and above the x-axis around the y-axis. Create a model of this volume with 6-10 slices.

A2 The volume is created by rotating the area under the parabola $y = 4 - x^2$ and above the x-axis around the x-axis. Create a model of this volume with 6-10 slices.

Model B

B1 The volume is a square pyramid whose base is a square. You decide the sidelength of the square on the base and the height of the pyramid. Create a model of the volume with 6-10 slices. *Optional/Bonus:* Model the volume with more (12-20) slices. *Optional/Bonus:* Create a model of the pyramid itself (no slices).

B2 The volume is a triangular pyramid with base an equilateral triangle. (See 7.2 # 36.) You decide the side-length of the equilateral triangle on the base and the height of the pyramid. Create a model the volume with 6-10 slices. *Optional/Bonus:* Model the volume with more (10-20) slices. *Optional/Bonus:* Create a model of the pyramid itself (no slices).

B3 The volume is a torus (doughnut shape). (See 7.2 # 47.) If the smaller radius is r, and the larger radius is R, the torus has equation $(x-R)^2+y^2 = r^2$. You decide on values for r and R. Create a model of this volume using the **washer method** and 5-10 slices. *Optional/Bonus:* Model the volume with more (12-20) slices. *Optional/Bonus:* Create a model of the torus itself (no slices).

B4 The volume is a torus (doughnut shape). (See 7.2 # 47.) If the smaller radius is r, and the larger radius is R, the torus has equation $(x - R)^2 + y^2 = r^2$. You decide on values for r and R. Create a model of this volume using the **cylindrical shell method** and 5-8 shells. *Optional/Bonus:* Model the volume with more (12-16) shells. *Optional/Bonus:* Create a model of the torus itself (no shells).

B5 The volume is a sphere. You decide the radius of the sphere. Create a model this volume using the **cylindrical shell method** and 5-8 shells. *Optional/Bonus:* Model this volume using more (10-16) shells. *Optional/Bonus:* Create a model of the sphere itself (no shells).

B6 The volume is a right circular cone. (See 7.2 #31). You decide the radius of the cone and the height of the cone. Model this volume using the **disk method** and 6-10 slices. *Optional/Bonus:* Model this volume using more (12-20) slices. *Optional/Bonus:* Create a model of the cone itself (no slices, nor shells).

B7 The volume is a right circular cone. (See 7.2 #31). You decide the radius of the cone and the height of the cone. Create a model of this volume using the **cylindrical shell method** and 5-10 shells. *Optional/Bonus:* Model this volume using more (10-16) shells. *Optional/Bonus:* Create a model of the cone itself (no slices, nor shells).