CS 4731 – A '02 – Final Exam

Name:

Instructions: Read questions carefully before answering. Do not hesitate to ask for clarifications. Show all work. **Note:** Partial credits are given, so do not leave anything blank! Use the back of the pages for extra paper as needed. Good luck!

Question 1 (20 points): Brief Descriptions

Give brief descriptions of the following:

a. (4 points) Hue of a color

b. (4 points) NURBS (**hint:** express their general form in terms of polynomials)

c. (4 points) Yaw (of a camera)

d. (4 points) Umbra and penumbra of a shadow

e. (4 points) Post filtering antialiasing technique

Question 2 (20 points): Transform Matrices

a. (6 points) What does the projection matrix in the openGL pipeline do? Explain in terms of the view volume, its shape and size before and after applying the projection matrix. Include an illustrative diagram.

b. (4 points) The openGL modelview matrix can be broken down into two component matrices. What are they? Describe them briefly.

c. (10 points) Assuming perspective projection, the plane of projection is at N = 0 and camera is at point (0, 0, -10) in viewing coordinates, what do each of the following points project to? Assume that no clipping occurs. **Hint:** Simply give the (x', y') values of the projections unto the plane of projection.

i. (5 points) (3, 4, 5)

ii. (5 points) (10, 15, -15)

Question 3 (20 points): Polygonal Meshes

a. (4 points) The Newell method is generally preferred instead of the dot product method for finding the normal to a convex polygon. Why?

b. (8 points) Describe a data structure to store a polygonal mesh. Give enough insight into what its main components are and how to use them.

c. (8 points) Give pseudocode to write a function to draw the meshes stored in your data structure in part b.

Question 4 (20 points): Flexible Camera Control /Raster Graphics

a.(12 points) Given as inputs the camera eye position, the lookAt (or COI) point and the up vector, describe how to form three basis vectors **u, v, n** for the camera coordinate frame. Using these basis vectors and the eye position, write out the full world to camera coordinate transformation matrix.

b. (8 points) The recursive flood fill algorithm works but is inefficient. Why? Specifically, what property of filled raster regions is typically used to improve the performance of this algorithm? Explain how this new algorithm improves the performance of the basic recursive fill algorithm and describe with pseudocode, this improved algorithm.

Question 5 (20 points): Visual Realism

a. (4 points) What is the major problem with Gouraud shading when shading polygons?

b. (4 points) What is the Mach Band effect in flat shading?

c. (6 points) Describe briefly the z-buffer Hidden Surface Removal

d. (6 points) Describe briefly the shadow buffer approach to rendering shadows