EECE 478 Midterm Exam
February 27, 2003

Name:

Student #:

The exam is worth 40 pts (20% of course grade). Assuming 1 point per minute, try to finish in 40 minutes.

Use the following transform notations:

- T(**v**) is translation by the vector **v**.
- S(s_x,s_y,s_z) is scaling by s_x in the x direction etc.
- $R_{\mathbf{v}}(\theta)$ is rotation by θ around the vector **v**.

1. Viewing (7pts)
   a. (5) Draw a picture of the pinhole camera model, clearly labeling the center of projection, view plane, focal length, field of view, and gaze direction.
   b. (2) Describe the location and view direction of the canonical pinhole camera in OpenGL.

2. Basic Transforms (5pts)
   a. (1) What is the inverse of the translation T(**v**)?
   b. (1) What is the inverse of the scaling transform S(s_x,s_y,s_z)?
   c. (1) What is the inverse of the rotation $R_x(\theta)$?
   d. (2) If $R_x(\theta)$ is represented as a matrix, what is the matrix equation for the inverse?

3. Using Transforms (10pts)
   a. (3) Assuming a combined model-view matrix **VM**, what is **V** for a camera at position **p** rotated by θ around the axis **v** from the canonical position.
   b. (3) Write the matrix equation for an *instance transform*.
   c. (4) Write the matrix equation for a rotation by **R** around the point **p**.

4. Geometry (6pts)
   a. (6) Describe two different techniques for reducing the complexity of geometry passing through a rendering pipeline without reducing apparent scene complexity?

5. Lighting (12pts)
   a. (4) What two shading components form the Lambertian shading model?
   b. (2) What component is added by the Phong shading model?
   c. (4) Given the four basic shading vectors (**l**, **n**, **r**, and **v**), what is the equation for the Lambertian shading model (without attenuation)?
   d. (4) What is the equation for the extra component added by Phong?