SOS Graphics Problems Week 6 Name(s) _____

Hand these in Lab Week 6, or in Class Week 7; just do them paper and pencil….

1) **3D Transforms:** What is the 4x4 matrix transform (in homogeneous coordinates) for the 3D transformations below. *Also give the inverse*.

   a) Scale by 5 in the z direction:

      The transform: The inverse:

   b) A rotation of 10 degrees about the x axis:

      The transform: The inverse:

   c) A projection onto the yz-plane.
      The transform: The inverse:

   d) A translation by 10 along x and by -5 along y.

      The transform: The inverse:

   e) A reflection through the xz-plane

      The transform: The inverse:

2) **Composition of 3D Transforms:** What is the sequence of transformations needed to achieve the operations given below. Also, include the corresponding inverse. You do not need to write out the 4x4 matrices. Instead, make use of the syntax:

Scale: $S(s_x,s_y,s_z)$
Translation: $T(t_x,t_y,t_z)$
Rotation: $R_x(\Theta)$, $R_y(\Theta)$, $R_z(\Theta)$.

a) A rotation of 20 degrees about an axis that goes through the point (a,b,c) and is parallel to the y axis.

The transforms:

The inverse:

b) A scale by 5 (with fixed point at the origin) along the direction defined by the line from (0,0,0) to (-1, 0, 1).

The transforms:

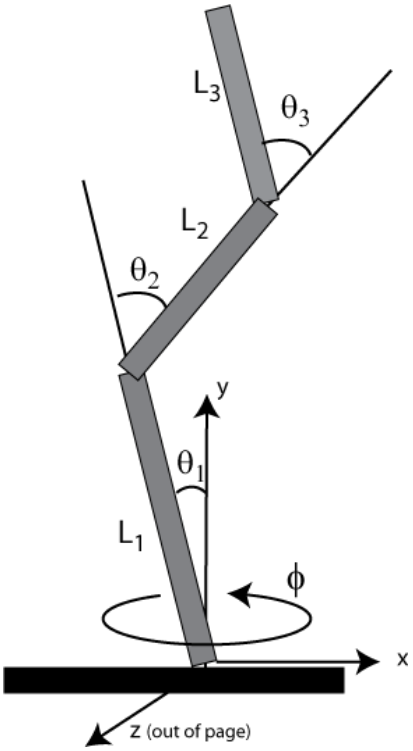
The inverse:

c) A scale by 2 with fixed point (2,3,4) and along the direction parallel to the x axis.

The transforms:

The inverse:

6) **Scene Graphs:** Below is a picture of a 3 segment robotic arm sitting on a base. Each segment is a cylinder of radius r and length L_i, with i=1,2,or 3. The arm segments can be rotated as shown.



Draw the scene graph for the robotic arm (not including the black base).

Assume that you have access to a cylinder primitive that has radius 1, height 1, is centered at the origin, and aligned with the z-axis.

Be sure to include all transformations. Scale transformations should be indicated as **S(s_X,s_Y,s_Z)**where you fill in specific values for s_X, s_Y, and s_Z. Similarly, translations and rotations should have the form **T(t_X,t_Y,t_Z), Rx(angle), Ry(angle),** and **Rz(angle).** *Indicate push/pops where needed*.