Dept: _____

Name: _____

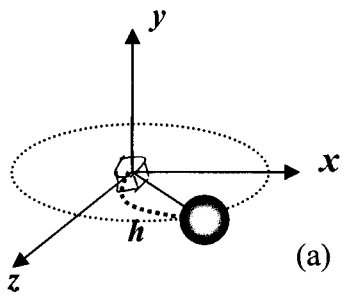
ID: _____

Introduction to Computer Graphics

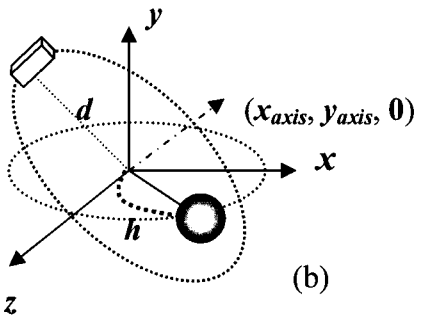
Midterm (April 2007) The maximum score is 105

1. (a) Please write pseudo codes and explain the "Bresenham's line-drawing algorithm". What's its advantage compared to "Digital Differential Analyzer line drawing"? (15%)
   (b) How to extend the "Bresenham's algorithm" to circle drawing? (10%)

2. In a 3D animation film, we would like to make a ball $\{P_{ball}[i]\ (i=1\sim n)\}$ revolve on its own y axis {with a constant angular velocity θ_r(per frame)}, and the ball also rotates around the origin {with a constant angular velocity θ_o(per frame)}.
   Please write pseudo-codes to show the following animation.
   (a) The camera is located at the origin. (15%)
   (b) The camera rotates around the axis (x_{axis}, y_{axis}, 0) with velocity θ_c . (10%)
   You can use perspective rendering functions **SHOW**() and sleep function **SLEEP**(33ms), and you can also use Identity matrix function: $\boldsymbol{I}$(), rotation matrix: $\boldsymbol{R}_x$(), $\boldsymbol{R}_y$(), $\boldsymbol{R}_z$(), translation matrix: $\boldsymbol{T}(x,y,z)$, trigonometric functions, e.g. sin(), asin() ,etc.



(a)



(b)

For instance,

```
k=0;
while(1) {
   k += 3;
   M = T(k, k, k);
   for (i=0; i<n; i++) {
      P_m[i] = M * P_ball[i];
   }
   SHOW(P_m);
   SLEEP(33ms);
}
```

3. In the graphics pipeline of perspective projection, we have several steps: "clipping", "projection to normalized view volume", “rasterization", “viewport transformation”, etc.
   (a) Please put these 4 steps in proper order and draw the corresponding working coordinates and view volumes or rectangles. (15 %)
   (b) Please explain why we use the normalized view volume and homogeneous coordinates. (10%)
   (c) "Z-buffer" is a popular approach for hidden surface removal. Given projected points of triangle models, please explain how to rasterize triangles with Z-buffer. (15%)

4. Suppose that you are going to render a wireframe scene with thousands of objects (e.g. SHIN SAN-GOU-MUSOU 4). Please explain your strategies or algorithms to improve the performance. (15%)