EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2004/2005

FIRST SEMESTER (Jan./Feb., 2006)

CS 301 - COMPUTER GRAPHICS

Answer all questions **Time allowed: Two hours**

1. (a) Explain **DDA**(*Digital Differential Analyzer*) algorithm to generate straight lines.

   How can you improve the performance of this algorithm.

   (b) Explain **Bresenham's** line drawing method and algorithm to generate straight lines with the slope less than one.

   Show how you would modify your algorithm to draw straight lines with any slope.

   Illustrate **Bresenham's** line drawing algorithm for the straight line with endpoints (-28, 35) and (-20, 25).

   (c) Describe and distinguish **Flood-Fill algorithm** and **Boundary-Fill algorithm** to fill regions in a raster display.

2. (a) Define the graphics terms **window** and **viewport**.

(b) Describe **Nicholl-Lee-Nicholl** clipping method to clip a given straight line against a clip window, with the aid of an example.

(c) Describe the **Sutherland-Hodgeman** polygon clipping method to clip a given polygon against a given clip window.

State the problems in clipping concave polygons in this method and show how you would clip them.

3. (a) Describe the basic transformations that would be useful in two-dimensional graphics and give the transformation matrices.
Give the transformation matrix to find the mirror image of a point with respect to y-axis.

(b) Let XOY be the usual rectangular coordinate system, and $X'OY'$ be another rectangular coordinate system as if OX' were obtained by rotating OX through an angle θ. Let P be a point whose coordinates are (x, y) with respect to (XOY).

Derive matrix to find the coordinates of P with respect to $X'OY'$.

Hence or otherwise derive a transformation matrix to find the mirror image of an object made up of straight lines with respect to the line y = mx.

4. (a) Give the equations for three-dimensional rotation about z-axis by an angle θ.

Deduce the equations for rotations about x-axis and y- axis from the equations in part(a) by angles α and β, respectively.

Give transformation steps for obtaining a composite matrix for rotation about an arbitrary axis.

(b) Define **parallel projection** and **perspective projection** in three-dimensional viewing.

Derive a transformation matrix to project a point $P(x, y, z)$ on to $Q(x_p, y_p, z_p)$ on a plane parallel to XY-plane but going through $(0, 0, z_{vp})$. The type of projection applied is perspective with reference point at $(0, 0, z_{rp})$.

Let OABC be a cubical object with the coordinates of each vertices are

(0, 0, 0), (25, 0, 0), (0, 25, 0) and (0, 0, 25), respectively, $z_{vp} = 5$ and $z_{rp} = 25$. Draw the projected object of the object OABC.