M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)

Term-End Examination

June, 2010

MMTE-004 : COMPUTER GRAPHICS

Time : 1½ hours   *Maximum Marks : 25*

Note :   *Question No. 1 is compulsory. Attempt any three questions out of questions 2–5. Use of calculator is not allowed.*

1.   State whether the following statements are true or false. Justify your answer with the help of a short proof or a counter example :   **2x5=10**

(a)   Rastor scanning is better than random scanning technique used in display.

(b)   In general, scaling and rotation are commutative operations.

(c)   The area of the ellipse that fits inside a rectangle with width W and height H is WH.

(d)   If the spacing between the knot sequence is uniformly doubled, the shape of the resulting B–spline curve changes.

(e)   There can be only one principal vanishing point in a projected image.

2. (a) In a computer graphics animation scene an **2** object is defined as a planar polyhedron. The object centre is located at position $P = [0, 0, 10]$, and the scene is drawn, as normal, in perspective projection with the –view - point at the origin and the view direction along the z–axis. Calculate the transformation matrix that will shrink the object in size by a factor of 0.8 towards its centre point.

(b) Clip the triangle that has VCS coordinates **3** of $P1 = (-4, -5, 7)$, $P2 = (0, -6, -10)$, $P3 = (0, -4, -12)$ to the perspective viewing frustum given by bottom $= -1$, top $= 1$, left $= -1$, right $= 1$, near $= 3$, far $= 9$. Show your intermediate results and use the following clipping order : top, bottom, left, right, near, far.

3. (a) Use the midpoint method and symmetry **3** consideration to scan convert the parabola $x = y^2$ for the interval $|y| \leq |0$.

(b) Consider three different raster systems with **2** resolutions of 640×480, 1280×1024 and 2560×2048. What size frame buffer in kilo bytes is needed for each of these systems to store 24 bits per pixel ? How long would it take to load a 1280×1024 frame buffer in the same system, if 104 bits can be transferred per second ?

4. (a) For a polygon with the vertices $V_0 = (10, 20)$, **3**
$V_1 = (20, 0)$, $V_2 = (30, 10)$, $V_3 = (40, 0)$,
$V_4 = (40, 40)$, $V_5 = (30, 30)$, $V_6 = (20, 40)$ and
$V_7 = (30, 20)$, prepare an initial sorted edge
list and then make the active edge list for
scan lines $y = 5, 20, 30, 35$.

(b) Write two difference each between : **2**

   (i) Parallel projection and perspective
       projection.

   (ii) Shear transformation and composite
        transformation.

5. (a) Let P(t) be a Bezier curve with control points **3**
$P_0, P_1, \ldots, P_n$. Prove that

$$|P_n - P_0| \leq \text{arc length } [P(t)] \leq \sum_{k=0}^{n-1} |P_{k+1} - P_k|.$$

(b) Transform the scene in the world coordinate **2**
system to the viewing coordinate system
with the view point at $(2, 2, 2)$. The view
plane normal vector is $(-1, -1, -1)$ and
the view up vector is $(0, 1, 0)$.

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