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JAYPEE UNIVERSITY OF INFORMATRION TECHNOLOGY, WAKNAGHAT

END SEMESTER EXAMINATION-2015

B.Tech. VI Semester (CSE/IT)

COURSE CODE: 11B1WCI611 MAX. MARKS: 45

COURSE NAME: Computer Graphics

COURSE CREDITS: 4 MAX. TIME: 3 HRS

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.*

Section A

1. Short Answer **[10x1.0Marks]**
   a. Explain the octree and its usage.
   b. What are parametric and non-parametric representations of a sphere?
   c. Write the 3D region codes and respective trivial acceptance and rejection tests for a line.
   d. Define the oblique perspective-projection frustum.
   e. Explain the Vanishing points for perspective projections.
   f. How Bresenham's line drawing algorithm is different from mid point line drawing algorithm?
   g. Calculate the plane parameters A, B, C and D for each face of a unit cube centered at the world coordinate origin.
   h. Explain the difference between modeling coordinate and world coordinate.
   i. Suppose we have a video monitor with a display area that measures 12 inches across and 9.6 inches high. If resolution is 1280 by 1024 and the aspect ratio is 1, what is the diameter of each screen point?
   j. Determine the resolution (pixels per centimeter) in the x and y directions for the video monitor in use on your system. Determine the aspect ratio, and explain how relative proportions of objects can be maintained on your system.

Section B

1.
   a. Carefully discuss the rationale behind the various tests and methods for calculating the intersection parameters u_1 and u_2 in the Liang-Barsky line clipping algorithm. **[3Marks]**
   b. Explain the meaning of dot product. What does it mean if dot product of two vectors is equal to zero?
   Let

$$a = \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}, b = \begin{bmatrix} 0 \\ 2 \\ 3 \end{bmatrix}, c = \begin{bmatrix} -2 \\ 2 \\ 0 \end{bmatrix}, d = \begin{bmatrix} 5 \\ -7 \\ 2 \end{bmatrix}$$

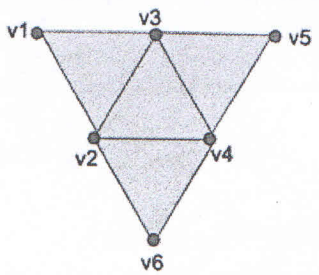
   Compute the following expressions or give the reasons why they are undefined:
   3a; c+d; c-d; $a^T a$; $c^T d$; aa^T **[3Marks]**

c. Show that the composition of two rotations is additive by concatenating the matrix representations for R(θ1) and R(θ2) to obtain R(θ1).R(θ2) = R(θ1+ θ2). **[3Marks]**

d. Show that two successive reflections about any line in the *xy* plane that intersects the coordinate origin is equivalent to a rotation in the *xy* plane about the origin. **[3Marks]**

2.

a. Define surface representation (i.e. Vertex Table and Surface Table) for a pyramid with a triangular base. When specifying the Surface Table ensure that when the cut-out below is folded into the pyramid the triangle surfaces face correctly in and out. Labels v1-v6 are vertex numbers, to be used in the construction of the tables.

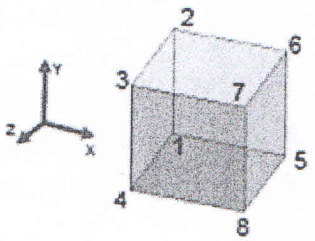


[3.5Marks]

b. Find the normalization transformation matrices for world coordinate to view coordinate system where object lies in x, y, z coordinate system as shown below. Find the new vertices of the object in view coordinate system.

Vertices

	x	y	z
V1	0	0	0
V2	0	1	0
V3	0	1	1
V4	0	0	1
V5	1	0	0
V6	1	1	0
V7	1	1	1
V8	1	0	1



[3.5Marks]

Section C

1. We consider the problem of using a Bezier curve to approximate a circle. There exist efficient algorithms to draw Bezier curves, so it is often convenient to reduce other primitives to them. Because of symmetry in a circle, we will consider only the positive quadrant, i.e. with arc endpoints (1, 0) and (0, 1). What are the control points of a quadratic Bezier curve that best approximates the quarter circle? In particular, the end-points and tangents at those end points of the approximating Bezier curve must match those for the quarter circle. What is the maximum error in this approximation, i.e. the error at the mid-point of the Bezier curve? **[8Marks]**
2. Write the homogeneous 4x4 matrices for the following transforms:
   - Translate by +5 units in the X direction
   - Rotate by 30 degrees about the X axis
   - The rotation, followed by the translation above, followed by scaling by a factor of 2.

   Also write the 4x4 transformation matrix for rotation about an arbitrary point (rather than the origin)? **[8Marks]**