

**BITS, Pilani – Dubai**  
**Dubai International Academic City, Dubai**

**Fourth Year (Computer Science & Engg.)**  
**First Semester, 2008-2009**

**Test 1 (Closed Book)**

**Course No: CS C471**  
**Date: 09<sup>th</sup> Oct 2008**  
**Duration: 50 minutes**

**Course Title: Computer Graphics**  
**Weightage: 20%**  
**Max. Marks. 20**

**Answer ALL questions**  
**4 marks for each question**

1. Derive the formula for the decision variable used to determine the y-increment in the midpoint line algorithm for drawing lines.
2. State the conventions used by the polygon scan conversion algorithm in counting the number of intersections of a scan line with a polygon boundary in the following cases:  
    The scan line passes through a polygon vertex.  
    A horizontal edge of the polygon lies on the scan line.  
Show, using diagrams, one example each of a scan line changing and not changing its in/out status in the cases listed above and verify that the conventions work properly.
3. Apply Cohen Sutherland line clipping algorithm for clipping the line joining (5, 8) with (11, 1) against the window having  $x_{\min} = 1$ ,  $y_{\min} = 2$ ,  $x_{\max} = 8$ ,  $y_{\max} = 7$ .
4. 2D transformations given below are applied in the order in which they are listed. Compose them and express the net result in a 3x3 matrix form.
  - a. Translation  $T(-3, -2)$
  - b. Scaling  $S(2, 2)$
  - c. Rotation  $R(90^\circ)$
  - d. Translation  $T(3, 2)$Apply the resulting transformation on the point (4, 2).  
Give an interpretation for the series of transformations given above.
5. Two rectangles R1 and R2 with sides parallel to coordinate axes are defined as below:  
    R1 :  $x_{\min} = a$ ,  $x_{\max} = b$ ,  $y_{\min} = c$ ,  $y_{\max} = d$   
    R2 :  $x_{\min} = p$ ,  $x_{\max} = q$ ,  $y_{\min} = r$ ,  $y_{\max} = s$   
Obtain a 2d transformation that will transform R1 to R2.



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**Fourth Year (Computer Science)**  
**First Semester, 2008-2009**

**Test 2 (Open Book)**

**Course No: CS C471**  
**Date: 09<sup>th</sup> Nov 2008**  
**Duration: 50 minutes**

**Course Title: Computer Graphics**  
**Weightage: 20%**  
**Max. Marks. 20**

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**(Text Book and Class Notes may be used.)**

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**Answer ALL questions**  
**4 marks for each question**

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1. Explain what is homogeneous coordinate system. State some of the properties of homogeneous coordinates. List the advantages of homogeneous coordinates over Cartesian coordinates.
2. Given a unit cube with one corner at (0, 0, 0) and the opposite corner at (1, 1, 1), derive the transformations necessary to rotate the cube by  $\theta$  degrees, about the diagonal from (0, 0, 0) to (1, 1, 1), in the counterclockwise direction when looking along the diagonal toward origin.
3. Develop a procedure for reflection of a three-dimensional object about an arbitrarily selected plane.
4. List the parameters used in the Synthetic Camera Model for specifying an arbitrary 3D view. Define each parameter and mention its effect on the final image. Give an example.
5. Give the viewing parameters for top, front, and side views of the object "house" defined in the textbook with the VRP in the middle of the window. Must the PRP be different for each of the views? Why or why not?



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**Fourth Year (Computer Science & Engg.)**  
**First Semester, 2008-2009**

**Quiz 01**

**Course No: CS C471**  
**Duration: 20 minutes**

**Course Title: Computer Graphics**  
**Max. Marks. 5**

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**ID No.**

**Name:**

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1. Which of the following is a major drawback of the basic incremental algorithm for drawing lines?
  - a. Number of points plotted is less
  - b. Number of points plotted is more
  - c. All types of lines cannot be drawn
  - d. Calculations with real numbers is required
2. For which of the following values of slope will the line drawn by the midpoint line algorithm show "staircase" effect?
  - a. 0
  - b. 1
  - c. 2
  - d. Infinity
3. What is the condition for terminating the basic midpoint circle algorithm?
  - a.  $y > x$
  - b.  $y \leq x$
  - c.  $x < 0$
  - d.  $y < 0$
4. Which of the following is not true about the active edge table (AET) used by the polygon scan conversion algorithm?
  - a. It is a static list.
  - b. It is sorted on the basis of the x-intersection value.
  - c. Each node in the list contains information about one edge of the polygon.
  - d. Information about the slope of an edge is stored in each node in the list.

5. The outcode used in the Cohen-Sutherland line clipping algorithm is formed by four bits representing the classification of a point w.r.t. the top, bottom, right, and left edges of the clipping rectangle. Which of the following is not a possible value for the outcode?
- 1010
  - 0101
  - 1001
  - 1100
6. Which of the following is not true about the Sutherland-Hodgman polygon-clipping algorithm?
- It is based on divide-and-conquer strategy.
  - The output may be a disconnected polygon.
  - It has exponential time complexity.
  - It can handle convex as well as concave polygons.
7. In which of the following cases does the Sutherland-Hodgman polygon-clipping algorithm output two points?  $s$  – the previous vertex;  $p$  – current vertex.
- both  $s$  and  $p$  inside
  - $s$  inside and  $p$  outside
  - $s$  outside and  $p$  inside
  - both  $s$  and  $p$  outside
8. What is the reason for choosing homogeneous coordinates for representing geometric transformations?
- For better efficiency
  - For user convenience
  - For convenience in composing transformations
  - For better understanding of transformations
9. Which of the following is not correct?
- $T(d_x, d_y, d_z) \cdot T(e_x, e_y, e_z) = T(d_x+e_x, d_y+e_y, d_z+e_z)$
  - $R_z(\theta_1) \cdot R_z(\theta_2) = R_z(\theta_1 \cdot \theta_2)$
  - $R_z(\theta_1) \cdot R_z(\theta_2) = R_z(\theta_1 + \theta_2)$
  - $S(s_x, s_y, s_z) \cdot S(t_x, t_y, t_z) = S(s_x \cdot t_x, s_y \cdot t_y, s_z \cdot t_z)$
10. Which of the following represents the transformation of mirror image about x-axis?
- $S(-1, 1)$
  - $S(1, -1)$
  - $T(-1, 0)$
  - $R(180)$

**BITS, Pilani – Dubai**  
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**IV Year (CS)**  
**First Semester, 2008-2009**

**Quiz 2**

**Course No: CS C471**  
**Date: 27<sup>th</sup> Oct 2008**  
**Duration: 15 minutes**

**Course Title: Computer Graphics**  
**Weightage: 5%**  
**Max. Marks. 10**

**ID No.**

**Name:**

1. The projections used in computer graphics are called geometric projections because
  - a. a plane is used to capture the image of the object.
  - b. objects projected are geometric objects.
  - c. both parallel and perspective projections included in it.
  - d. straight lines are used to find the images of points on the object.
2. Which of the following statements is correct?
  - a. In perspective projection no projector is perpendicular to the plane of projection.
  - b. In parallel projection all projectors are orthogonal to the plane of projection.
  - c. The centre of projection is at infinity for parallel projection.
  - d. Parallel projection produces images like photographs.
3. Which of the following is true about vanishing points?
  - a. Any set of parallel lines will meet at a vanishing point when projected.
  - b. It is the projection of a point at infinity.
  - c. It is a point on an object that disappears after projection.
  - d. Vanishing points are produced by orthographic projections.
4. What is the maximum number of vanishing points that a projection can have?
  - a. One
  - b. Two
  - c. Three
  - d. Any number of

5. How many isometric projections can an object have?
- Only one
  - Only three
  - Only eight
  - Any number of
6. In which of the following is cabinet projection a special case of?
- Orthographic
  - Perspective
  - Oblique
  - Isometric
7. Which of the following pairs of homogeneous coordinates represent the same point?
- (1, 2, 1) and (2, 4, 2)
  - (1, 2, 1) and (0, 1, 0)
  - (1, 2, 1) and (1, 2, 2)
  - (1, 2, 1) and (2, 4, 1)
8. Which of the following transformation is not used in the window-to-viewport transformation in 2D?
- Translation
  - Rotation
  - Scaling
  - All these are used
9. For which of the following the direction of projection not specified?
- Orthographic projection
  - Oblique projection
  - Axonometric projection
  - Perspective projection
10. In which type of projection do we get equal foreshortening along three principal axes?
- Isometric projection
  - Cabinet projection
  - Cavalier projection
  - Perspective projection



**BITS, Pilani – Dubai**  
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**IV Year (CS)**  
**First Semester, 2008-2009**

**Quiz 3**

**Course No: CS C471**  
**Date: 15<sup>th</sup> Dec 2008**  
**Duration: 15 minutes**

**Course Title: Computer Graphics**  
**Weightage: 5%**  
**Max. Marks. 5**

**ID No.**

**Name:**

1. Which type of continuity guarantees that the directions, but not the magnitudes, of the two segments' tangent vectors are equal at a join point?
  - a.  $C^0$
  - b.  $G^0$
  - c.  $C^1$
  - d.  $G^1$
2. What is the maximum order of continuity provided by cubic splines?
  - a.  $C^1$
  - b.  $G^1$
  - c.  $C^2$
  - d.  $G^2$
3. Which of the following is not a property of a cubic Bezier curve segment?
  - a. Is defined by four control points.
  - b. Passes through all the control points.
  - c. Lies within the convex hull of the control points.
  - d. Each coordinate is a cubic polynomial in one parameter.
4. What is the expansion of NURBS?
  - a. Non Uniform Rational B Splines
  - b. Nonrational Uniform Relational B Splines
  - c. Nonrational Uniform Relational Beta Splines
  - d. Non Uniform Relational B Splines
5. What is the normal to the plane with equation  $Ax + By + Cz + D = 0$ ?
  - a. (A, B, D)
  - b. (B, C, D)
  - c. (A, C, D)
  - d. (A, B, C)

6. Which of the following does not normally require surface normals?
- Shading the surface
  - Interference detection
  - Intersection calculation
  - Calculating offsets in CNC machining
7. What is the name of the property that a given representation represents only one solid?
- valid
  - accurate
  - unique
  - unambiguous
8. Which of the following is not used to define a regularised union operation?
- interior
  - exterior
  - closure
  - union
9. If a given representation corresponds to only one solid, then the scheme is called -----.
- complete
  - unique
  - homogeneous
  - valid
10. What is the name of the representation that uses the equation  $f(x, y, z) = 0$  to represent a surface?
- Parametric
  - Explicit
  - Implicit
  - None of the above.





**BITS, Pilani – Dubai**  
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**Fourth Year (Computer Science)**  
**First Semester, 2008-2009**

**Comprehensive Examination**

**Course No: CS C471**  
**Date: 24<sup>th</sup> Dec 2008**  
**Duration: 3 Hours**

**Course Title: Computer Graphics**  
**Weightage: 40%**  
**Max. Marks. 40**

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**Answer ALL questions**  
**5 marks for each question**

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1. Apply the midpoint circle algorithm, with second order differences, to generate the first four points on the circle  $x^2 + y^2 = 25$ .
2. Apply Cohen-Sutherland algorithm for clipping the line joining (0, 3) to (8, 7) against the window with  $x_{min} = 2$ ,  $x_{max} = 8$ ,  $y_{min} = 2$ , and  $y_{max} = 6$ .
3. A rectangle has diagonally opposite corners (4, 2) and (8, 4) and sides parallel to the coordinate axes. Find a transformation that will scale the rectangle by a factor 2 in the x-direction and 3 in the y-direction with out changing its centre. Express your result as a single 3 x 3 matrix.
4. A Bezier curve is defined by the following control points.  
 $p_0(0, 0)$ ,  $p_1(1, 1)$ ,  $p_2(2, 1)$ ,  $p_3(3, 0)$   
Evaluate the point on the curve corresponding to the parameter  $u = \frac{1}{2}$ . Draw the control polygon, curve and mark the point you have evaluated. Calculate the slope of the curve at its end points.
5. Write an algorithm in pseudo-code to display a Bezier surface by drawing the parametric curves in the u and v directions by approximating them by line segments. You may assume that a 3D-line drawing function is available for generating the display. Select the set of input parameters to make the program highly adaptable.
6. Describe briefly the Constructive Solid Geometry (CSG) scheme for representing solid objects. What are the advantages and disadvantages of this method? Define a simple object like a table with flat top and four legs created from the single primitive unit cube.

**[P.T.O.]**

7. Explain the depth-sort algorithm for determining visible surfaces. Show two examples of cyclic overlap and how it can be resolved. In what situation is this algorithm better compared to others?
8. Describe Gouraud and Phong shading methods for displaying planar polyhedral objects. Compare the advantages and disadvantages of these methods.

