Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(IT)/SEM-7/IT-703A/2011-12

2011

COMPUTER GRAPHICS

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$10 \times 1 = 10$

i) After arbitary 2D transformation, a pair of parallel lines

a) become intersecting

b) become coincident

c) remain parallel

d) become circular arcs.

ii) In Bresenham's circle rasterization algorithm, for the first quadrant, if (x, y) is the current pixel position, y-coordinate for the next position can be

a) $y + 1$ b) only y

c) y or $y - 1$ d) $y + 1$ or $y - 1$.

iii) Homogeneous coordinate (9, 6, 3, 3) is equivalent to the Cartesian coordinate given by

a) (1, 2, 3) b) (9, 6, 3, 1)

c) (9, 6, 3) d) (3, 2, 1).

iv) A rectangle is drawn at the centre of the display screen. It is necessary to carry out a zoom-in process so that the size of the rectangle is doubled and it remains at the centre of the screen. The sequence of transformations needed are

a) only scaling

b) scaling & then rotation

c) scaling & then shearing

d) translation, scaling and then translation again.

v) For an order n Bezier curve with blending function $J_{n\ i}(t)$, $0 \le i \le n$, $0 \le t \le 1$, $\sum_{i=0}^{n} J_{n\ i}(t)$, for any arbitrary value of t in the range 0 to 1 is equal to

a) 0·5 b) 5·0

c) 0·1 d) 1·0.

vi) A 3D object is rotated about the y-axis, followed by perspective projection of the rotated object on the $x - y$ plane from a centre of projection on the z-axis. This sequence of transformations is equivalent to

a) Single point perspective projection

b) Two point perspective projection

c) Three point perspective projection

d) Oblique projection.

vii) In Sutherland-Cohen 2D line clipping, end-point-codes for a line AB are (0101) and (0001). This line is

a) Partially visible b) Totally visible

c) Totally invisible d) None of these.

viii) For filling a particular polygon, the run-time storage requirement for the simple seed-fill algorithm, as compared to the scan-line, seed-fill algorithm is

a) more b) same

c) less d) none of these.

ix) Raster refresh display systems use colour look-up tables to

a) increase system speed

b) increase display resolution

c) increase number of colour shades

d) decrease bit-plane access time.

x) Two curves are said to be joined with first order continuity if

a) end point of one curve is the same as starting point of the other.

b) slopes at the end of first curve and start of the second curve are equal.

c) curvatures at the end of first curve and start of second curve are equal

d) both (b) and (c) conditions are true.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A monochromatic graphics display system has 525 scan lines with display screen height : width ratio of 9 : 16. Each pixel is displaceable in 512 shades.

   i) How many pixels are displayed on the screen ? 2

   ii) What is the picture storage memory size ? 3

3. Changing the sequence of a given set of control points results in different Bezier curves. Why ?

4. Show that the area of a 2D object after it is transformed by an arbitrary 2 × 2 transformation matrix is dependent only on the area of the original object and the 2 × 2 transformation matrix.

5. Write down the seed-fill algorithm to fill an eight-connected region.

6. a) Is it possible to clip lines against a symmetric octagonal window using Cohen-Sutherland's approach ? The octagon is symmetrically placed with respect to the coordinate axes and all its sides are equal. If your answer is yes, how ? If it is no, why ? 3

   b) Can the end-point-codes as used in regular-window clipping be extended to Cyrus-Beck 2D window clipping ? If yes, how ? It not, why ? 2

7. a) Show formally that parallel projection is actually a special case of perspective projection. 3

   b) What is an isometric projection ? 2

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

8. a) Derive transformation matrix to rotate a 2D object about origin by angle θ in the CCW direction. 5

   b) Derive transformation matrix to reflect a 2D object about a line $y = mx + c$. 5

   c) Magnify the triangle given by vertices A (0, 0), B (1, 1) and C (5, 2) to twice its size but keeping position of vertex C fixed at (5, 2). 5

9. a) Give the mid-point rasterization algorithm for an ellipse. 8

   b) Rasterize the first quadrant of an origin centered ellipse with major axis 2 * 6 and minor axis 2 * 3. Both are coincident with the coordinate axes. 7

10. a) Describe the Sutherland-Hodgman polygon clipping algorithm. 7

    b) A regular 2D clipping window has its lower-left and upper-right corners at (100, 10) and (160, 40) respectively. Find visible portion of lines A (50, 0), B (120, 30) and C (120, 20), D (140, 80) using mid-point-subdivision algorithm. 8

11. a) Derive transformation matrix to rotate a 3D object by an angle θ (CCW) about a line passing through points $P(x_1, y_1, z_1)$, $Q(x_2, y_2, z_2)$. 10

b) What is homogeneous coordinate system ? How is it related to the Cartesian coordinate system. 2 + 3

12. a) Why are cubic polynomials extensively used to generate space curves ? 3

b) Discuss the advantages and disadvantages of using degree-2 and degree-4 polynomials for curve fitting. 3

c) Derive the conditions to be satisfied when joining two Bezier curves with second order continuity at the join. Discuss geometric interpretation for these conditions. 9