This question paper contains **4** printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **1153**

Unique Paper Code : **2342012304**

Name of the Paper : **Computer Graphics**

Name of the Course : **B.Sc. (H) Computer Science**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

The paper has *two* Sections A and B. Section A is compulsory.

Attempt any *four* questions from Section B. Each question is of **15** marks.

Answer *all* parts of a question together.

Use of non-programmable calculator is allowed.

Section–A

1. (*a*) Construct a translation matrix to translate a Point P from position (*h*, *k*) to the origin. 3

(*b*) What does $h = 1$ represent in homogeneous coordinates ? Give example. 3

(*c*) What is RGB color model ? How is RGB model represented ? 3

(*d*) What is the three-step process to fill a polygon ? 3

(*e*) Define the following terms : 3

- persistence
- bitmap
- refresh rate.

P.T.O.

(*f*) What are the drawbacks of DDA line drawing algorithm ? 3

(*g*) List the characteristics of key frame animation. 3

(*h*) What is the vanishing point in perspective projection ? How is it related to center of projection ? 3

(*i*) While scan converting ellipse, explain the use of gradient. 3

(*j*) Prove that two rotations are additive. 3

Section–B

2. (*a*) Consider two Bezier curve segements defined by control points $P_0(20, 20)$, $P_1(40, 50)$, $P_2(60, 20)$ and $P_3(80, 20)$. Another curve segment is defined by $Q_0(a, b)$, $Q_1(c, d)$, Q_2 and Q_3. Find the point Q_0 and Q_1 such that two curves join smoothly and C1 continuity exists between them. 7

(*b*) Use the Sutherland-Hodgman polygon clipping algorithm to clip a polygon with vertices A(1, 1), B(10, 4), C(7, 12) and D(3, 8) against a clipping window defined by vertice (2, 2), (8, 2), (8, 8) and (2, 8). 8

3. (*a*) The triangle ABC with position vectors [1 0], [0, 1] and [–1 0], is transformed by transformation matrix, T = [[3, 2], [–1, 2]] to create a second triangle A*B*C. Compute the area of new triangle by using area of the original triangle and transformation matrix. 4

(*b*) Distinguish between parametric and geometric continuity. 4

(*c*) Consider a polygon with vertices PQRS with coordinates P(2, 3), Q(7, 8), R(9, 4) and S(4, 9). Fill the polygon using scan line fill algorithm. Trace the contents of the Active Edge Table for each scan line. 7

4. (*a*) Rasterize a line segement from (3, 2) to (10, 6) using Bresenham's line drawing algorithm. 7

(*b*) Give the 4 × 4 homogeneous 3D transformation matrix that will achieve the same effect as each of the following transformations : 8

(*i*) Rotate counter clockwise about the Z-axis by 45° and then translate right by 3 units.

(*ii*) Scale the object by a factor of 2 uniformly along all axes.

(*iii*) Find a two-point perspective projection of a line AB with endpoints A(3, 2, 4, 1) and B(3, 2, 8, 1) where the plane of the projection is $z = 0$ and centre of projections are at $y = 2$ and $z = -1$. Also, find two vanishing points.

5. (*a*) Differentiate between Cabinet and Cavalier projections. 4

(*b*) Explain the Area subdivision method for visible surface determination. 4

(*c*) Derive the mathematical formula for Phong illumination model considering ambient, diffuse and specular reflection. 7

6. (*a*) Prove that intersecting lines remain intersecting after generalized 2D transformations. 4

(*b*) What do you mean by hidden surfaces ? Explain Z-Buffer algorithm for visible surface determination. 4

(*c*) Derive the Basis matrix for parametric cubic Hermite curve. Also, obtain its blending functions. Write *two* characteristics of Hermite curves. 7

7. (*a*) Consider a Clip Window PQRS with the coordinates P(100, 100), Q(100, 200), R(200, 200) and S(200, 100). Clip a line A(50, 50) B(250, 300) against this clip window using Cohen Sutherland algorithm. 7

(*b*) Explain the architecture of a raster-scan display and its advantages. How long would it take to load a 640 × 480 frame buffer with 12 bits per pixel, if 1024 bits can be transferred per second ? 4

(*c*) What is anti-aliasing ? Explain any *one* anti-aliasing technique in detail. 4