Ref. No. EX/PG/MMD/T/129A/2018

MASTER IN MULTIMEDIA DEVELOPMENT EXAMINATION, 2018
(2nd Semester)

Subject : ADVANCED GRAPHICS AND ANIMATION

Time : Three hours

Full Marks : 100

Answer any FIVE questions
All parts of a question must be answered together

1 (a) What are Blending Functions. What are the advantages of Parametric Equations? 6

(b) A cubic curve has given blending functions, a, b, c are constants. Find its basis matrix. 6
$L_0 = 1 - at + bt^2 - 2ct^3$, $L_1 = 2bt - ct^2 + at^3$, $L_2 = a - 2t + 3t^2$,
$L_3 = -3 - at^2 - ct^3$

(c) Derive parametric equations of a quadratic curve which goes through the three points $(0, 1), (1, 2), (2, 0)$ in such a way that the middle point divides the curve in ratio 1 : 2 8

2 (a) Define a Bezier spline. How is a Hermite spline different from a Catmull-Rom spline? 6

(b) A quadratic Bezier curve is associated with the following control points. Find its equation. $P_0(-2, 1)$, $P_1(-1, 2)$, $P_2(2, -1)$ 6

(c) A cubic Hermite spline $C(t) = 1 + 2at - 3bt^2 + 4at^3$ has equal slopes at start and end points. Find a relation between constants a and b. 8

3 (a) Why are Homogeneous coordinates preferred for transformation operations? How can homogeneous coordinates be converted to Cartesian coordinates? 6

(b) Find the transformation that aligns the vector with the principal axis 6
(i) $3i - 4j$ with the positive X-axis (ii) $4i + 3j$ with the positive Y-axis.

(c) Reflect the triangle $A(2, 5)$, $B(3, 7)$, $C(4, 6)$ about the line $y = 2x + 5$ and find its new vertices. 8

4 (a) What is a Window-to-Viewport Transformation? For a parametric curve $C(t) = \{x(t), y(t)\}$ what is the unit normal vector? 6

(b) Obtain a transformation that maps a window with diagonal joining A(2, 5) and B(6, 7) to a viewport with diagonal joining P(0, 0) and Q(1, 1). 6

(c) (i) Find the tangent and normal to the curve $C(u) = (1 - u^2, 2u + 5)$ at point $A(-3, 1)$. 8

(ii) Find the area between the line $y = 2x$ and parabola $y = 2 + x^2$ between $x = -2$ and $x = 2$.

5 (a) Differentiate between dot-product and cross-product of vectors. Explain whether the following are valid operations for three vectors : (i) $(a \bullet b) \times c$ (ii) $(a \times b) \bullet c$ 6

(b) A straight line passes through points (6, 3, –5) and (2, 1, –4). Find its equation in both Cartesian and vector forms. 6

(c) Where does the line $r = (1,4,-3) + t(6,-3,2)$ meet the plane $x - 5y + 2z = -4$? 8

6 (a) Describe the processes of Lathing and Extrusion for generating 3D surfaces. Provide mathematical expressions for the resulting surfaces. 6

(b) Find the point(s) of intersection between the surface $S: \ 2x^2 - 3y^2 + 4z^2 = 5$ and the line $L\ (t+1,\ t-2,\ t+3)$. 6

(c) Find the normal to the surface $S(2u^2 + 2,\ v^2,\ 2uv)$ for $u > v$ at the point $P(10, 9, 12)$. 8

7 (a) What is Flat Shading Model? Differentiate between Ambient and Diffuse reflections. 6

(b) Light along direction $L = 2i - j + 3k$ falls on a surface with normal $N = 3i - 2j + k$. Calculate the reflected ray. Also verify that angle of incidence is equal to angle of reflection. 6

(c) Consider a plane surface $2z - 4 = 0$ on which light is incident along $L = i - j + k$ and is viewed along $V = i + j + k$. Assuming following surface properties : $m = 2,\ k_a = 0.25,\ k_d = 0.35,\ k_s = 0.45$, determine intensity of reflected light at a point on the plane using flat shading model, as a percentage of the source intensity. Take the ambient intensity as 1/10–th of the source intensity. 8

8 Write short notes on FOUR of the following 20

(a) Continuity Conditions (b) Quad Tree (c) Fractals (d) Texture Mapping (e) B-spline (f) Axonometric Projection