

Computer Graphics, End Sem Exam, 29 April 2022

(Full Marks: 35, Time allowed: 3 hours)

1. As has been discussed in the class consider the case of a general perspective projection, where the COP is located at the origin and the projecting plane passes through a point (x_0, y_0, z_0) in the direction of unit vector l, m, n . Let us consider a set of parallel lines having direction cosines p, q, r . A point $P(a, b, c)$ lies on these lines. Now these lines will get projected on the plane, with a finite vanishing point (VP) on the plane. Derive the coordinates of the VP. (5)

2. The parametric equation of a straight line, in terms of its x, y, z components are:

$$x(u) = g_{1x}(1-u) + g_{2x}(u); y(u) = g_{1y}(1-u) + g_{2y}(u); z(u) = g_{1z}(1-u) + g_{2z}(u)$$
 Find the geometry matrix 'B' and coefficient matrix 'M' for the above parametric equation. (2+2)

3. For Bezier curves the tangent to the curve at the parameter value $t=0$ points along the line joining the first and second control points, and that the tangent at $t=1$ point along the line joining the second last and last control points. It suffices to prove that at $t=0$

$$\frac{dx}{dt} = k_1(x_1 - x_0)$$
 and at $t = 1$

$$\frac{dx}{dt} = k_2(x_3 - x_2)$$
 Where x_0, x_1, x_2, x_3 are the x coordinates of the control points, and k_1, k_2 are constants. What are the values for k_1, k_2 ? (3)

4. Write down the blending function matrix 'F' for PC curves and its tangent 'F'' (derivation not required). Show the behavior of the curves on the same plot. (4)

5. In specular reflection, the angle between the reflection vector R and viewing vector V is given by α . If N is the surface normal and S the light source vector, then derive the relationship between $\cos \alpha$ and
 - a. vectors R and V . (1)
 - b. vectors V, N and S . (5)

6. Write down Phong's illumination model and label its different parameters, as taught in the class (No other definitions will be considered). (5)