

Computer Graphics, End Sem Exam, 29 April 2022**(Full Marks: 35, Time allowed: 3 hours)**

- 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)
- 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)

- 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)

- Write down the blending function matrix 'F' for PC curves and its tangent ' F^u ' (derivation not required). Show the behavior of the curves on the same plot. (4)
- 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
 - vectors R and V. (1)
 - vectors V, N and S. (5)
- Write down Phong's illumination model and label its different parameters, as taught in the class (No other definitions will be considered). (5)