[6261]-115

S.E. (Robotics and Automation Engineering)
COMPUTER GRAPHICS FOR ROBOTICS
(2019 Pattern) (Semester- IV) (211512)

Time : 2½ Hours] [*Max. Marks : 70*

Instructions to the candidates:

1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
2) *Figures to the right side indicate full marks.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Use of Calculator is allowed.*
5) *Assume Suitable data if necessary.*

Q1) a) A quaternion q_1 rotates 30° about Y axis and quaternion q_2 rotates 90° about Y axis. Obtain the interpolation quaternion at parameter $t = 0.3$.**[12]**

b) With suitable examples, explain the application of natural neighbour method for 3D surface generation **[5]**

OR

Q2) a) Use Lagrange method to determine y co-ordinates of a point having x-co-ordinate as 6 on a curve which is generated by using 4 data points having following co-ordinates: **[12]**

x	2	5	7	10
y	8	12	6	10

b) Explain the application of quaternions to obtain the combined roll, pitch and yaw motion of a robot gripper. **[5]**

Q3) a) Obtain x, y, and z co-ordinate of a point on the Bazier surface patch at $u = 0.3$ and $v = 0.7$ using following control points: **[9]**

$$\begin{bmatrix} (2,8,5) & (4,8,10) & (6,8,14) & (8,8,6) \\ (2,6,12) & (4,6,8) & (6,6,10) & (8,6,15) \\ (2,4,8) & (4,4,12) & (6,4,8) & (8,4,5) \\ (2,2,4) & (4,2,8) & (6,2,5) & (8,2,10) \end{bmatrix}$$

b) Obtain x-y co-ordinates of a point on Bezier curve at parameter value $t = 0.5$ considering control points as $(1,1)$, $(4,10)$, $(8,2)$ and $(14,15)$. **[8]**

OR

Q4) a) Explain the applications of B spline and Bezier curves in robot path planning. **[7]**

b) Find the midpoint (i.e. point at parameter $t = 0.5$) of a Hermite cubic spline with two end points as (1,1) and (6,5) and corresponding tangent vectors are (0,4) and (4,0). **[10]**

Q5) a) A plane contains vectors $a = 2i + j - 3k$ and $b = 2i - j$. A point in the plane is (2,5,1). Obtain the equation of plane. **[10]**

b) A triangle has vertices $P_1(2,6)$, $P_2(6,9)$, $P_3(4,11)$. Determine whether point $P(5,8)$ lies inside the triangle, outside triangle or on the edge. If it is on the edge then mention that particular edge. **[8]**

OR

Q6) a) Obtain a point (P) in a plane parallel to XZ plane and containing point (1,1,1). Assume the values of arbitrary scalers for two vectors as 2 and 1 respectively. **[12]**

b) Write note on: Application of analytic geometry in robotics. **[6]**

Q7) a) What do you mean by an outer product? What are the properties of outer product? **[9]**

b) Explain the applications of applied geometric algebra for modelling of robotics physics. **[9]**

OR

Q8) a) Write note on: Geometric product for vectors **[9]**

b) Write short note on: Reflection and rotation **[9]**

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