

Total No. of Questions: 8]

SEAT No. :

PA-1316

[5925]-349

[Total No. of Pages : 2

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

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Neat diagrams must be drawn wherever necessary.
- 2) Figures to the right indicate full marks.
- 3) Use of Calculator is allowed.
- 4) Assume suitable data, if necessary.

- Q1)** a) A quaternion q_1 rotates 0° about Y axis and quaternion q_2 rotates 90° about Y axis. Obtain the interpolation quaternion at parameter $t = 0.4$. [12]
- b) Explain the application of Inverse distance weighting method for surface generation. [5]

OR

- Q2)** a) Obtain the interpolation vector the vectors $v_1 = [2 \ 0]$ and $v_2 = [0 \ 1]$ at $t = 0.3$. [12]
- 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 co-ordinates of a point on Bezier curve at parameter value $t = 0.4$ considering control points as (2,5), (3,8), (5,3) and (2,15). [12]
- b) Explain the applications of B spline and Bezier curves in robot path planning. [5]

OR

- Q4)** a) Obtain x,y, and z co-ordinate of point on the quadratic Bzier surface patch at $u=0.5$ and $v=0.5$ using following control points: [10]
- $p_{00} = (0.0.0)$ $p_{01} = (1.1.0)$ $p_{02} = (2.0.0)$
 $p_{10} = (0.1.1)$ $p_{11} = (1.2.1)$ $p_{12} = (2.1.1)$
 $p_{20} = (0.0.2)$ $p_{21} = (1.1.2)$ $p_{22} = (2.0.2)$
- b) What are B-spline curves? How the geometric continuity is determined for B spline curves? [7]

P.T.O.

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

b) Determine the point of intersection of two lines AB and CD having coordinates of point A(3, 1, 2), point B (4, 4, 6), point C(2, 1, 5) and point D(3.857, 2.285, 2.428). Consider parameter t for line AB as 0.7 and parameter s for line CD as 0.3. [8]

OR

Q6) a) Obtain the equation of the plane inclined to Y axis and Z axis by 45° . It is parallel to X axis and contains a point (0, 0, 1). [10]

b) Write note on: Application of analytic geometry in robotics [8]

Q7) a) Demonstrate with example, the outer product of 2 Vectors in 3 dimensional space. [9]

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

OR

Q8) a) Show that the multiplication of basis blades e_3 and e_{13} is $-e_1$ [9]

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

