

QP Code : 15827**(3 Hours)****[Total Marks : 100**

N.B.:

- (1) Question No.1 is compulsory.
- (2) Attempt any four questions out of remaining six questions.
- (3) Assume suitable data wherever required.

- Q1. a) How robots are classified? **5 marks**
 b) Explain basic four steps for transferring Frame k-1 to frame k and write general transformation matrix **5 marks**
 c) Explain bounded deviation algorithm for straight line motion. **5 marks**
 d) Define 1) Pixel function, 2) Shrink Operator m 3) Swell operator 4) DOF 5) Dexterous work envelope **5 marks**
 e) What are the advantages & disadvantages of PLC system . **5 marks**

- Q2. a) Explain the characteristics of the Inverse Kinematics solutions. and what are the different methods to solve Inverse Kinematics problem **10 marks**
 b) Show that the fundamental rotation and translation matrices associated with the unit vectors commute . i.e., $\text{Trans}(\lambda, i^k) \text{Rot}(\phi, k) = \text{Rot}(\phi, k) \text{Trans}(\lambda, i^k)$. **10 marks**

- Q.3.a) F and M are two fixed and mobile right handed orthonormal coordinate frames . M frame was translated by 2 units along f^2 axis of F and 2 units along axis f^3 of F. Then , the M frame was rotated about axis f^3 of F by $\pi/2$ radians . If $(p)^M = (0, 0, 1)^T$ Find $[p]^F$ **10 marks**

- b) Obtain the Inverse Kinematics solution of the 4 axis Adept - 1 SCARA robot with its IK algorithm starting from the arm matrix. Explain Each joint variable computation in brief. **10 marks**

- Q.4. a) Compare area descriptors over to line descriptors ? **5 marks**
 b) Explain inverse arm kinematics solution for a 2 DOF articulated coordinate robot **5 marks**
 c) Explain how to normalize the performance index for removing the effects of average light intensity. **10 marks**

- Q.5. a) Explain how the chain code of a boundary is constructed? **10 marks**
 b) Explain the template matching algorithm for object recognition. **10 marks**

- Q.6. a) Explain workspace analysis of 5 axis Rhino XR-3 Robot arm **10 marks**
 b) Write a PLC ladder logic programme for 4 junction traffic light controller **10 marks**

- Q.7. Write a short note on **20 marks**
 i) Specifications of robots
 ii) Linear interpolation method .
 iii) Screw transformation
 iv) Gross motion planning