

Code No: 09A70305

R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech IV Year I Semester Examinations, November - 2013

Robotics

(Mechanical Engineering)

Time: 3 Hours

Max. Marks: 75

**Answer any Five Questions
All Questions Carry Equal Marks**

- 1.a) Discuss the following types of automation
i) Fixed automation
ii) Flexible automation
b) Give the applications of the following types of grippers
i) Magnetic grippers
ii) Vacuum cups. [7+8]
- 2.a) Find the transformation matrices for the following operations on the point $2\hat{i} - 8\hat{j} + 3\hat{k}$.
i) Rotate 30° about x-axis and then translate -5 units along y-axis.
ii) Translate 2 units along y-axis and rotate 60° about z-axis.
b) Find the rotation matrix corresponding to the set of Euler angles ZYX. [8+7]
3. Find the direct kinematic equations for the parallelogram arm shown in Fig. 1. Assume the dimensions for the links. [15]

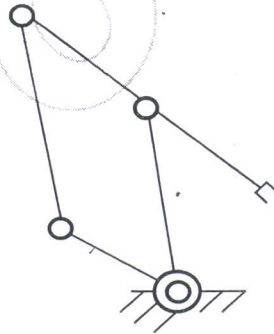


Fig. 1

4. Compute the jacobian for the 3R manipulator shown in Fig. 2. [15]

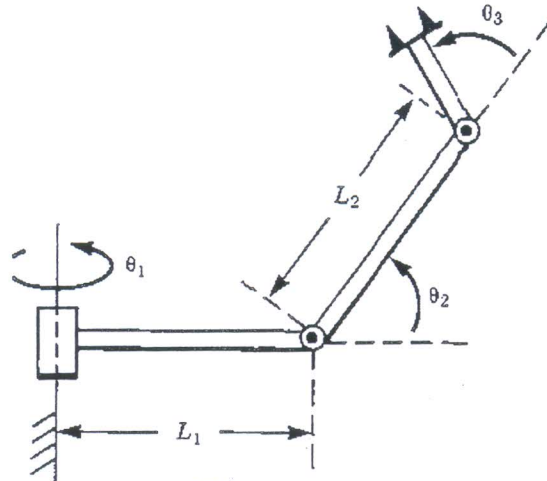


Fig. 2

- 5.a) Explain the iterative algorithm of Newton-Euler formulation for the manipulator dynamics.
- b) Derive an expression for the derivative of a time varying rotation matrix with respect to time in terms of a skew-symmetric matrix and itself. [10+5]
- 6.a) A single link robot with a rotary joint is motionless at $\theta = 30$ degrees. It is required to move the joint to $\theta = 90$ degrees in 5 seconds. Find the coefficients of a cubic polynomial that accomplishes this motion and brings the manipulator to rest at the destination. Plot the velocity and acceleration of the joint as a function of time.
- b) What are the advantages of joint-variable space trajectory planning? [9+6]
- 7.a) Differentiate between pneumatic and hydraulic actuators.
- b) Explain the principle of working of resolvers.
- c) List different types of tactile sensors? Explain any one. [15]
- 8.a) What are the general considerations in robot material handling? Explain.
- b) Explain how robotics can be applied to inspection automation. [8+7]