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**Second Semester M.Tech. Degree Examination, June/July 2015**

**Robotics for Industrial Automation**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions.**

- 1 a. List the various robot drive system? Explain briefly. (10 Marks)
- b. Obtain the transformation of spring mass damper system by reducing the mathematical model to block diagram. (10 Marks)
- 2 a. Define the following terms:
 

i) Work volume	ii) Spatial resolution	
iii) Accuracy	iv) Repeatability	(08 Marks)
- b. Explain Euler angle and Euler transformations of robot manipulators. (12 Marks)
- 3 Derive the displacement matrices for three link cylindrical with spherical wrist by DH representation of Fig.Q3. (20 Marks)

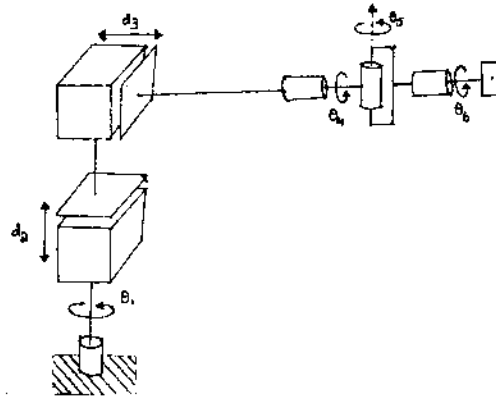


Fig.Q3

- 4 a. A spherical manipulator as shown in Fig.Q4(a) has the first two links, each having a length 1250 mm, and the prismatic joint allows a maximum sliding range of  $d_3 = 500$  mm. The limits of the revolute joints permits a maximum range of  $\theta_1 = 180^\circ$  and  $\theta_2 = 90^\circ$ . Find the structural length index when the tool tip to be at a distance of 1500 in maximum reach position from the center of the workspace. (10 Marks)

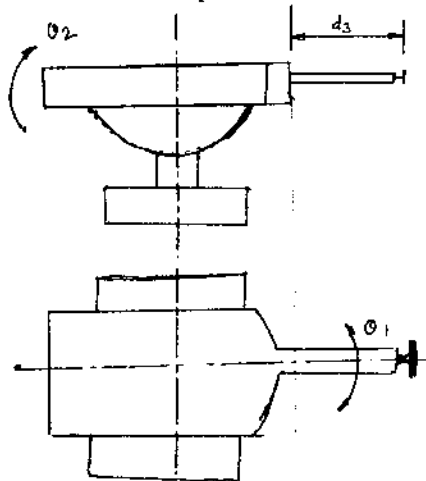


Fig.Q4(a)

- b. Explain the general design consideration of 4-3-4 and 3-5-3 trajectories. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. By revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 5 a. In a Stanford arm manipulator, the second joint is to move from an initial position of 20 degrees to a final position of 68 degree in 4 seconds. Assume that the joint starts and finishes at zero velocity and find the cubic polynomial that satisfies that motion. Calculate the position, velocity and acceleration of this joint at intervals of 1 second and show their plots against time. (12 Marks)
- b. What are end effectors? Briefly explain the concept of using end effectors as tool. (08 Marks)
- 6 a. Explain the various methods of robot programming. (10 Marks)
- b. Explain WAIT, SIGNAL AND DELAY commands. (10 Marks)
- 7 a. With a neat sketch, explain the robot language structure. (10 Marks)
- b. What are proximity sensors? Explain inductive sensors with a neat diagram. (10 Marks)
- 8 a. What are the goals of AI research? Explain. (08 Marks)
- b. Explain in brief the AI techniques used in Robotics. (12 Marks)

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