First Semester M.Tech. Degree Examination, Dec. 2013 / Jan 2014.
Robotics for Industrial Automation

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions.*

1   a. Describe the robot components.   **(06 Marks)**
     b. Define the Degrees of Freedom (DOF), with a sketch.   **(06 Marks)**
     c. With neat sketch, explain the types of reference frames attached to a robotic structure. **(08 Marks)**

2   a. With neat sketch, explain determination of [A] MATRIX using D – H convention. **(10 Marks)**
     b. A plannar manipulator arm with one rotary one prismatic joint as shown in fig.Q2(b). Compute Jaccobian matrix for that.   **(10 Marks)**

Fig.Q2(b)
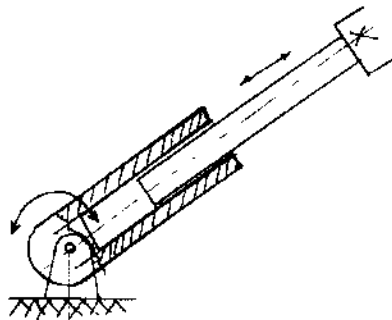
3   a. Define and illustrate the link and joint parameter. Explain their uses. **(08 Marks)**
     b. For the 3 – DOF (RRP) manipulator arm shown in fig. Q3(b), obtain the orientation and position of tool point P of the joint variable vector is $q = [90^0 \ - 45^0 \ 100mm]^T$, with $x_1 = 50mm$ and $x_2 = 40mm$.   **(12 Marks)**


Fig.Q3(b)
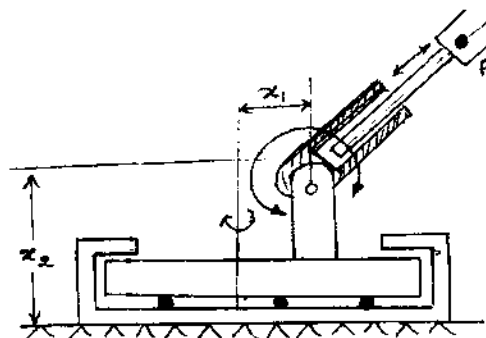
4   a. Briefly explain the trajectory planning with respect to a PTP robot considering a modified constant velocity motion of the joint and illustrate by suitable sketches and also obtain switching timing.   **(12 Marks)**
     b. A joint of a robot manipulator traverses from an initial position of 25^0 to a final position of 75^0 in 5 seconds. Assuming a fifth degree polynomial and a starting acceleration of 4 deg/sec^2. Determine the acceleration at the end of 5 seconds.   **(08 Marks)**

5 Obtain equations for joint velocities, kinematic energy and potential energy of a robot arm shown in fig. Q5. **(20 Marks)**

Fig.Q5
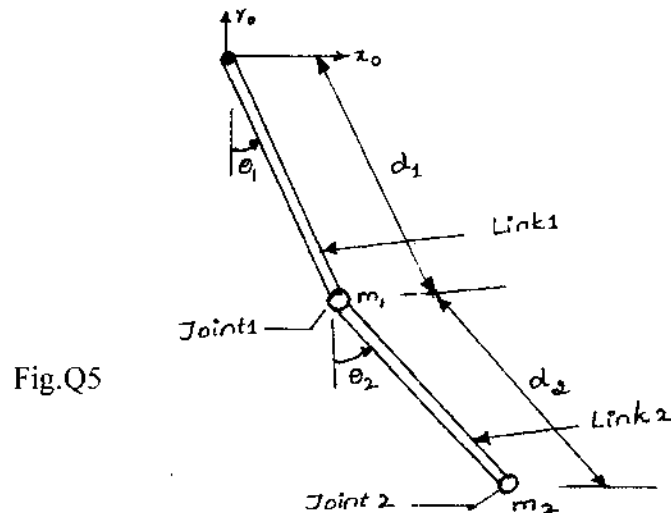
6 a. Discuss various programming methods used in robot teaching. **(10 Marks)**
  b. Give any five industrial application of robot in the manufacturing industry. **(10 Marks)**

7 a. With a neat sketch, explain the components and their functions in a robot vision system. **(10 Marks)**
  b. Explain ultrasonic and inductive sensor. **(10 Marks)**

8 Write short notes on any Four of the following :
  a. Servo motor.
  b. Quantizing and Encoding.
  c. Rotation matrix and Homogenous Transform.
  d. Repeatability and Accuracy.
  e. Motion control VAL commands. **(20 Marks)**

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