Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014**

**Subject code: 1724709** **Date: 25-06-2014**

**Subject Name: Futuristic Manufacturing Systems**

**Time: 02:30 pm - 05:00 pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Consider Cartesian manipulator with spherical wrist shown in figure 1. Where, P is the end effector position. Using D-H notation Construct **07**

1. Set of robotic coordinate frame
2. A table for joint parameter
3. Each joint individual matrix

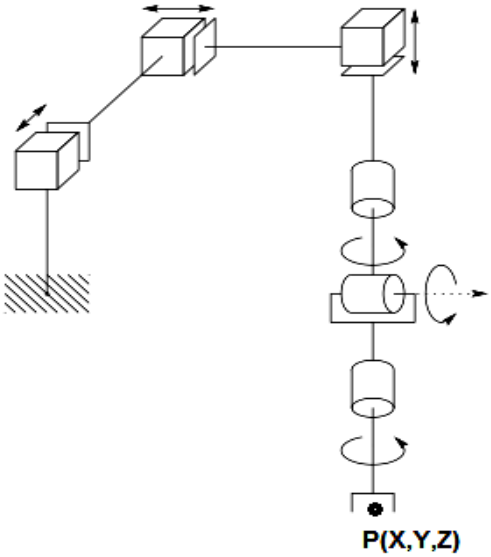


Figure 1. Cartesian manipulator with spherical wrist

**(b)** Derive Denavit Hartenberg (D-H) Convention. Write down the algorithm of D-H notation. When is D-H useful? **07**

**Q.2** **(a)** Discuss the difference between polar arm and articulated arm configuration. **07**

**(b)** Define different types of sensors used Robotics and explain any two briefly. **07**

**OR**

**(b)** What are five different types of joints used in robotics arms and wrists? Explain with sketches. **07**

**Q.3** **(a)** A point $P(8,5,2)^T$ is attached to a frame (n,o,a)and is subjected to the transformations described. Find the coordinates of the point relative to the reference frame at the conclusion of transformations. **07**

(1) Rotation of $90^0$ about the a-axis,

(2) Followed by a rotation of $90^0$ about the o-axis,

(3) Followed by a translation of [8,-3,4]

**(b)** The following table gives the information regarding the parts and the machines on which they are to be processed. **07**

1. Determine the similarity coefficients between all the machines.
2. Use Single Linkage Cluster analysis method and develop a dendrogram.
3. Identify the cell configurations in a similarity range of 0.5 ï 0.8.
4. How will you resolve the problem of exceptional elements?

| Parts | Machines | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | × | | × | | × |
| 2 | × | × | | × | × |
| 3 | × | × | | × | × |
| 4 | × | × | | × | × |
| 5 | × | | × | | × |
| 6 | | | × | | × |
| 7 | × | | × | | × |
| 8 | × | | | × | × |
| 9 | × | × | | × | |
| 10 | × | × | | × | |

**OR**

**Q.3 (a)** An FMS consists of four station plus a load/unload station. Station1 is a load/ unload station one server. Station 2 performs milling operations with three servers (three identical CNC milling machines). Station 3 performs drilling operations with two servers (two identical CNC drill machines). Station 4 is inspection station with one server thatôs performs inspections on a sample parts. The machines are connected by a part handling system that has two work carriers and a mean transport time = 3.5 min. The FMS produces four parts, A, B, C and D. Determine: **07**

(a) Maximum production rate of the FMS
(b) Corresponding production rate of each part
(c) Utilization of each machine in the system
(d) Average utilization of the system

| Part j | Part mix $P_j$ | Operation k | Description | Station i | Process time $t_{ijk}$ | Frequency $f_{ijk}$ |
|---|---|---|---|---|---|---|
| A | 0.1 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Mill | 2 | 20 | 1.0 |
| | | 3 | Drill | 3 | 15 | 1.0 |
| | | 4 | Inspect | 4 | 12 | 0.5 |
| | | 5 | Unload | 1 | 2 | 1.0 |
| B | 0.2 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Drill | 3 | 16 | 1.0 |
| | | 3 | Mill | 2 | 25 | 1.0 |
| | | 4 | Drill | 3 | 14 | 1.0 |
| | | 5 | Inspect | 4 | 15 | 0.2 |
| | | 6 | Unload | 1 | 2 | 1.0 |
| C | 0.3 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Drill | 3 | 23 | 1.0 |
| | | 3 | Inspect | 4 | 8 | 0.5 |
| | | 4 | Unload | 1 | 2 | 1.0 |
| D | 0.4 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Mill | 2 | 30 | 1.0 |
| | | 3 | Inspect | 4 | 12 | 0.333 |
| | | 4 | Unload | 1 | 2 | 1.0 |

**(b)** What is FMC? What is the difference between the primary and secondary handling in flexible manufacturing systems? **07**

**Q.4 (a)** Briefly explain about the Opitz coding system used in group technology. Discuss the advantage and disadvantage of Opitz code system. **07**

**(b)** Explain the methodology to be followed for developing a retrieval type CAPP system. **07**

**OR**

**Q.4 (a)** Explain the following term in GT: (1) mono code (2) poly code (3) mixed code. **07**

| | | | |
|---|---|---|---|
| | **(b)** | Discuss the computerized elements of CIM systems and explain the briefly the advantage that will be gained by implementation of CIM. | **07** |
| **Q.5** | **(a)** | Basic principal of Rapid Prototyping also explain the steps of RP Techniques. | **07** |
| | **(b)** | Differentiate the flexible automation and programmable automation. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Classification of Rapid Prototyping processes. Explain Laminated object manufacturing (LOM). | **07** |
| | **(b)** | What is an end effector? Which factor is considering design the end effector? | **07** |

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