Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIIIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 182002 Date: 12/05/2012

Subject Name: Automated Manufacturing II

Time: 10:30 am – 01:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary and clearly mention the same.**
3. **Draw NEAT schematic diagrams wherever necessary. Shabbily drawn diagrams may not be appreciated.**
4. **Figures to the right indicate full marks.**

Q.1 **(a)** Draw neat schematic diagrams of PUMA, SCARA and Cartesian robot configurations and differentiate amongst them from application point of view. **07**

(b) Describe the meaning of trajectory planning for a robotic arm and draw trajectories of position, velocity and acceleration for cubic polynomial function and linear function with parabolic blends. Bring out suitable application/s for both trajectory functions. **07**

Q.2 **(a)** Describe the following ways of grouping the components to take advantage of their similarities: **07**

1. Visual observation
2. Part classification and coding
3. Production Flow Analysis

Compare the relative merits and demerits amongst them.

(b) 1. Briefly describe the factors affecting the load carrying capacity of a robot. **04**

2. The risks encountered with fixed automation are related to the volume of product and product itself. – Evaluate the statement. **03**

OR

(b) Programming of limited sequence robot, point to point servo controlled robot and continuous path servo controlled robot is not same. – Justify the statement. **07**

Q.3 **(a)** 1. Differentiate amongst accuracy, repeatability, control resolution and spatial resolution in context of robotic arm. Support your answer with neat diagram. **05**

2. Explain the utility of Jacobian matrix in robot kinematics analysis. **02**

(b) A point P(6,3,2) is attached to a moving frame (n,o,a), which is subjected to the transformations about a fixed reference frame described next. Find the coordinates of the point P relative to the fixed reference frame at the end of all transformations using multiplication of transformation matrices. The transformations are: **07**

1. A rotation of 90 degree about Z-axis of fixed reference frame
2. Followed by translations of (4,-3,7) about X,Y and Z axes of fixed reference frame respectively
3. Followed by a rotation of 90 degree about Y-axis

Also find out the coordinates of the point P relative to the fixed reference frame using graphical method also.

OR

Q.3 **(a)** Describe shortly the various applications of robot vision system with suitable examples. **07**

(b) Calculate the joint variables of cylindrical robot, if we place the origin of hand at point P(2,4,7) in space. Do not use the D-H representation method for calculating joint parameters. The sequence of transformations of the robot under considerations are as follows: **07**

1. Translation of 'r' along X-axis
2. Rotation of 'α' (alpha) about Z-axis
3. Translation of 'b' along Z-axis

Q.4 **(a)** Draw neat schematic diagrams of any three robot gripper mechanisms. Describe briefly the importance of following robot grippers: **3+4**
Magnetic grippers, Inflatable grippers, Adhesive grippers, Vacuum cups

(b) Five machines will constitute a Group Technology (GT) cell. The from-to data for the machines are as follows. **3+4**

Machine No.		To				
		1	**2**	**3**	**4**	**5**
From	**1**	0	10	80	0	0
	2	0	0	0	85	0
	3	0	0	0	0	0
	4	70	0	20	0	0
	5	0	75	0	20	0

Your tasks:

1. Determine the most logical sequence of machines for the data given above using Hollier Method-II (using 'from-to' ratio).
2. Construct the balanced material flow diagram for the data in hand.

OR

Q.4 **(a)** For the robot configuration shown in Fig.1, produce parameter table of D-H Transformations between successive joints and find out total transformation matrix using D-H representation. Also find out the coordinates of a point in space when θ_1 = 20 degree and θ_2 = 20 degree for link 1 and link 2, respectively. **07**

(b) 1. Illustrate the concept of composite part in Group Technology with suitable example and neat sketches. **03**

2. Using the flow diagram explain briefly the role of various inputs to Material Requirement Planning. **04**

Q.5 **(a)** 1. Define flexibility in context of a manufacturing system and describe following flexibilities in brief: Volume flexibility, Routing flexibility, Lead time flexibility **04**

2. Differentiate amongst alpha-class, beta-class and gamma-class of robot intelligence. **03**

(b) 1. Suggest the most suitable robot configuration for the following applications with one strong contributing reason for your choice in each case: **04**

i. To load unload machines
ii. To execute work significantly below its base
iii. To achieve high repeatability of motion
iv. To transfer heavy loads

2. Explain working principle of LVDT with neat sketch. **03**

OR

Q.5 **(a)** A spherical robot, equipped with 3 encoders each emitting 1000 pulses per revolution, is having two rotational joint and one linear joint with an arm of fixed length of 500 mm. The linear axis motion is achieved with an aid of 10 mm pitch, double start screw. One encoder is mounted on the motor shaft of the linear axis. Other two encoders are mounted individually on motor shafts of two separate rotational axes. The reduction ratio of 22:1 exists on two rotational axes between motor shaft and its output. Assume that the limit of rotation is 360 degree on both the rotational joints. **07**

Your Tasks:

Determine the worst spatial resolution of the given spherical robot and produce the sketch of the same.

(b) Draw line diagrams of the following and bring out the significance of them in short.

1. Rotary absolute encoder **02**
2. Linear incremental encoder **02**
3. Strain gauge as a force sensing device for a robot arm **03**

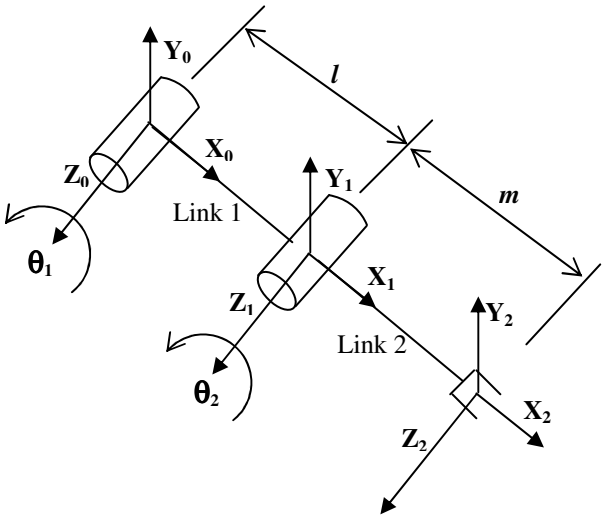

Fig.1 Planar Robot Manipulator

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