53 (CS 812) RBTC

2017

ROBOTICS

Paper : CS 812

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Define Robot Anatomy and also mention the links and joints in a robot manipulator in a diagram.

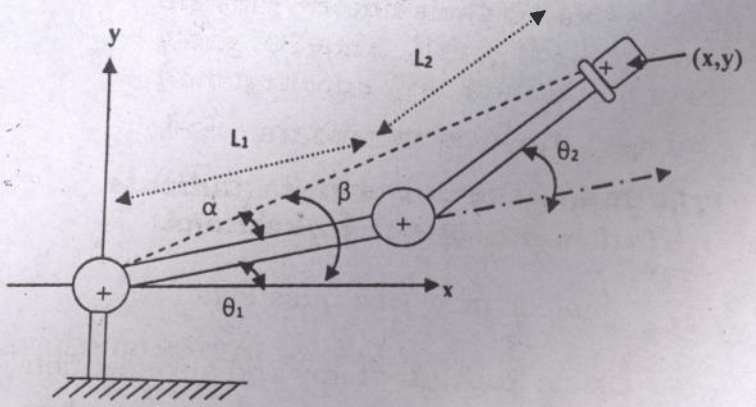
   (b) Write down the manipulator joints with their notations and diagrams. Sketch the following manipulator configuration : *(i)* TLO *(ii)* TRR *(iii)* LOO.

   (c) Mention the various kinds of tasks which are done in Robotics.

   6+8+6=20

Contd.

2. *(a)* Describe 2-DOF robot manipulator (R-R) and also define the position of end arm in the world space (Forward transformation) using the vector of links L_1 & L_2. Calculate the reverse transformation (Q_1 & Q_2) from the figure given below :



(b) Two points $a_{uvw} = (9, 6, 5)^T$ and $b_{uvw} = (6, 2, 4)^T$ are to be translated a distance +6 unit along *OX*-axis & –2 unit along *OZ*-axis. Using the appropriate homogeneous transformation matrix, determine the new points a_{xyz} and b_{xyz}.

(Hint : Forward transformation *i.e.* Co-ordinates *x* & *y*).

14+6=20

3. *(a)* For the vector, $V = 15i + 10j + 30k$, rotate an angle of 45° about the *x*-axis. Derive the rotation transformation.

(b) Explain the degree of freedom in Robotics and related robot joints also. Mention the link and joint parameters.

(c) Calculate the T matrix for the given parameter values in table '1' using D-H transformation.

Joint i	α_i	a_i	d_i	θ_i
1	0	a_0	0	θ_0
2	–45	a_1	0	θ_1
3	0	0	d_1	θ_2
4	45	0	d_2	θ_3

6+6+8=20

4. *(a)* A robot performs a loading and unloading operation for a machine tool as follows :

(i) A Robot pickup part from conveyor and loads into machine (Time = 4.5 *sec*)

(ii) Machining cycle in automatic manner with Time=22.0 *sec*

(iii) Robot reclaim part from machine and deposits to outgoing conveyor with Time=3.5 *sec*

(iv) Finally Robot moves back to pickup position with in Time=1.2 *sec.*

Every 25 work parts, the cutting tools in the machine are changed which takes 3.0 minutes. The uptime efficiency of the robot is 95%; and the uptime efficiency of the machine tool is 96% which rarely overlap. Determine the hourly production rate.

(b) Explain the Fourier transform and Convolution theorem.

10+10=20

5. Write down the short notes on the following : 5×4=20
(any four)

(i) Image preprocessing methods

(ii) Preventive maintenance

(iii) Humanoid Robot

(iv) Industrial Robot

(v) Entropy.

6. Differentiate between the following : 5×4=20
(any four)

(i) 3-DOF *Vs* 4-DOF

(ii) Active Sensor *Vs* Passive Sensor

(iii) Revolute Joint *Vs* Prismatic Joint

(iv) Sensor Fission *Vs* Sensor Fusion

(v) Erosion *Vs* Dilation Operators.

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