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.*

Q. No. ***4*** *and* ***5*** *is* ***Compulsory.***

1. *(a)* Write down the capacities of a humanoid robot and also explain the primitives of Robotics. 8

   (b) What is an Industrial Robotics and its capabilities ? 7

   (c) Explain the End-effectors and also its types. Mention the difficult tasks which are done by Robots. 5

2. *(a)* What is the difference between Semi-autonomous and Autonomous robotics ? 8

(b) What kind of tasks are required to perform the robots control in autonomous manner ? 6

(c) What is a mobile robot odometry ? Define the role of actuator control for applying force. 6

3. *(a)* A robot performs two different kinds of work for a machine tool, such as loading and unloading operation,

(i) A robot pick-up part using transporter and loads into machine within (8·5*secs.*).

(ii) An automatic machining cycle in (32·5*secs.*) time.

(iii) Robot collects part from machine and deposit to the moving outside conveyor within (6·8*secs.*) time.

(iv) Now, Robot moves back to pick up position in (7·2*secs.*) time.

Every 20 work parts, the cutting tool in the machine are changed which takes 4·0 minutes. The uptime efficiency of the robot is 96%; and the uptime efficiency of the machine tool is 97% which never overlap.

Find out the hourly production rate. 8

(b) What are the *four* types of Robot Control System ? Draw the figure with different level. 8

(c) Write down the Common body-and-arm configurations with the rotation also. 4

4. *(a)* Draw a diagram of manipulator with a configuration (RR:R) and also determine the position of 'Joint 3' in 3-DOF arm. Information related to links and joints are as follows :

(i) The angle between the x-axis and link 1 $(L_1) = \theta_1$

(ii) The angle between the link 1 (L_1) and link $(L_2) = \theta_2$

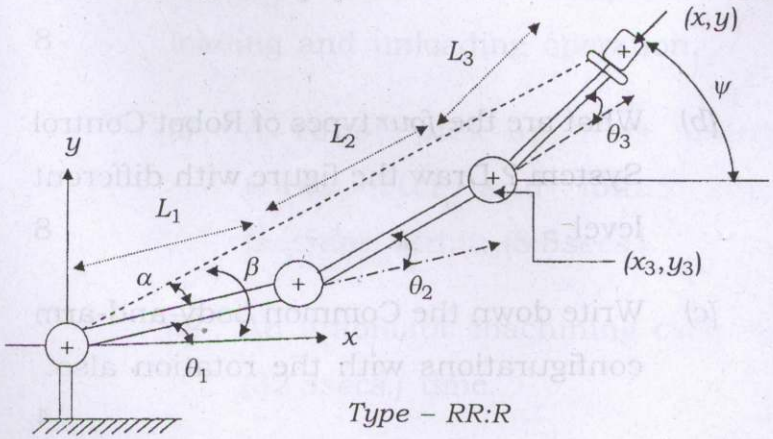
(iii) The angle between the link 2 (L_2) and link $(L_3) = \theta_3$

(iv) The angle between the x-axis and Wrist assembly = ψ

i.e. $\psi = \theta_1 + \theta_2 + \theta_3$

Calculate the reverse transformation ($\theta_1, \theta_2, \theta_3$ and ψ) from the given figure.

{Hint : Use 2-DOF for finding the two angles first) 14



Type – RR:R

(b) What is the Kinematics Function of link, and how to measure the link length and link twist ? 6

5. (a) Two points $a_{uvw}=(4,3,5)^T$ and $b_{uvw}= (7,3,5)^T$ are to be rotated 60° degree about the *OZ* axis. Find out the new points a_{xyz} and b_{xyz} corresponding to the reference co-ordinate system.

(Hint : Forward transformation i.e., co-ordinates x and y) 10

(b) Write down the commands for Robots in space with the examples. 4

(c) Write down the properties of digital images and also define the grayscale dilation and erosion. 6

6. (a) True *or* False : $1\times10=10$

(i) Radar works like a flash camera in Microwave Band

(ii) Convolution is band on shifting property

(iii) If the events are more predictable, then H increases

(iv) Three levels of safety sensor system is used in Robotics.

(v) Lateral position error, when the parts are chamfered

(vi) Angular error, when chamfer crossing as the peg rotates about the grip

(vii) RCC stands for regular Center Compliance

(viii) AML stands for a machine language

(ix) CSG stands for constructive solid geometry

(x) The syntax of state change in GDP.

(b) Write down the short notes : ***(any four)*** 2·5×4=10

(i) CONVOLUTION (image analysis)

(ii) ENTROPY (image information related)

(iii) MTBF and MTTR

(iv) RCC device parameters

(v) Hybrid Control Architecture for Robot

(vi) Revolute joints and Prismatic joints.
