53 (CS 812) RBTC

2019

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)* Describe the Wrist configuration with a diagram. Mention the Coordinate systems with a diagram. 5

   (b) Mention the Polar Coordinate and Cylindrical Body-and-Arm Assembly notations with diagrams. Sketch the TVR : R manipulator configuration. 6

Contd.

(c) Define the end-effector and its types. Mention the applications of industrial robots. 5

(d) What is the Kinematics function of link? How to measure link length and link twist? 4

2. (a) Draw the figures of sensor fission and action-oriented sensor fusion. 4

(b) What are the important attributes considered for the sensors? 8

(c) What is sensor suite and how to design the sensor suite? 4

(d) Explain the attributes of sensor suite and mention the variants of redundancy attribute. 4

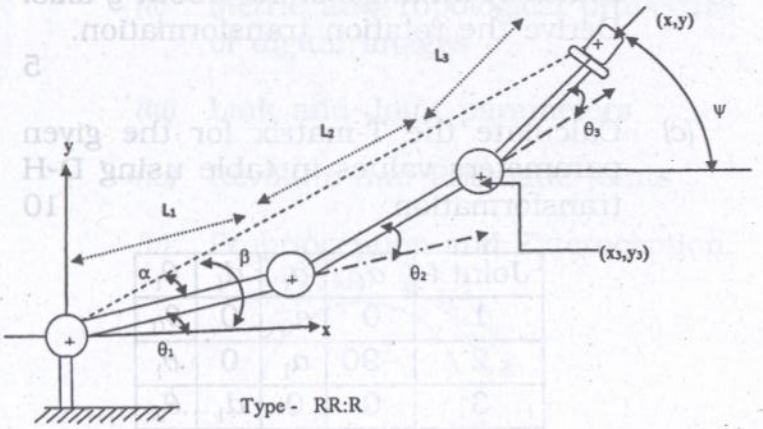
3. (a) What types of variables are used in INS? 3

(b) How does the GPS system work? Mention the uses of DGPS. DGPS is a Proprioceptive *or* Exteroceptive — Justify it. 5

(c) Define the Sensor device and also the different types of sensors with examples. 4

(d) Mention the development of algorithm for solving object recognition problem in the computer vision and what are the challenges occurred during object recognition. 8

4. (a) Derive the reverse transformation (θ_1, θ_2 and θ_3) of this 3-DoF robot arm in the figure given below. 15



(b) Calculate these three angles from the derived formulae 4.(a) for the link values 4, 5 and 6 with respect to L_1, L_2 and L_3 respectively. The values of x and y are 12 and 10 respectively. 5

5. (a) Two points $a_{uvw} = (6, 3, 8)^T$ and $b_{uvw} = (8, 6, 4)^T$ are to be rotated 60 degree about the oz-axis. Find out the new points a_{xyz} and b_{xyz} corresponding to the reference coordinate system. 5

(b) For the vector $V = 25i + 20j + 30k$, rotate by an angle of 45° about y-axis. Derive the rotation transformation. 5

(c) Calculate the T-matrix for the given parameters values in table using D-H transformation. 10

Joint i	α_i	a_i	d_i	θ_i
1	0	a_0	0	θ_0
2	−90	a_1	0	θ_1
3	0	0	d_1	θ_2
4	90	0	d_2	θ_3

6. (a) Write short notes on the following : ***(any four)*** 4×3=12

(i) Sensor fusion false positive/ negative

(ii) Entropy

(iii) Denavit-Hartenberg (D-H) Representation

(iv) DoF in a plane and space

(v) Four stages of representation of objects.

(b) Differentiate between the following : ***(any four)*** 4×2=8

(i) Active and Passive Sensors

(ii) Metric and Topological properties of digital images

(iii) Link and Joint parameters

(iv) Revolute and Prismatic joints

(v) Proprioception and Exteroception.