COLLEGE OF ENGINEERING, PUNE.

End Semester Examination
(IE 415)   Robotics   (Elective)

Programme : **B.Tech. (Instru. & Control)**　　　　Date : 27ᵗʰApril 2013
Specialisation : Instrumentation & Control Engg.　　Max. Marks : 50
Year : 2012– 13　　　　　　　　　　　　　　　　　Duration : 03:00 hrs.

Instructions: -　1) Figures to the right indicate full marks.
　　　　　　　　3) Draw neat figures wherever required. Assume suitable data if required.

Q.1　a)　Discuss in detail the list of specifications required for selection of suitable robotic arm for industrial applications. Also discuss the major factors affecting on the better performance of the robot arm. Give the sample range for each of the specification parameter.　[05]

　　b)　Compare in detail **any two** of the following terms related to robot system ?　[05]
　　　　i)　Hard Automation and Soft Automation
　　　　ii)　Electrical Actuators and Pneumatic Actuators
　　　　iii)　Proximity Sensors and Tactile Sensors
　　　　iv)　PUMA robots and SCARA robots

Q.2　a)　Robotic gripper is to be designed for to lift the 4.75 N of steel plate. Using a factor of safety 2 suggest proper cup size if two such type of grippers are to be employed to lift the plate by creating 18.5 kPa vacuum pressure. Draw the suction cup diagram to understand its working.　[05]

OR

　　a)　Write a detail note with figure on 'Estimation of force' for various types of Robot grippers.　[05]

　　b)　Explain the working of electric motors, used for an industrial robot, with the help of a necessary circuit diagram and speed-torque characteristic curve.　[05]

Q.3　a)　With the help of suitable sketch derive and explain the following equation of Link Transformation Matrix as given below.

$$[\, ^{i-1}T_i\,] = Rot(\, X_{i-1}, \alpha_{i-1}\,) \cdot Trans(\, X_{i-1}, a_{i-1}\,) \cdot Rot(\, Z_i, \theta_i\,) \cdot Trans(\, Z_i, d_i\,)$$

Also give the homogeneous transformation matrix for above equation.　[04]

OR

　　a)　Write a short note on **any one** of the following terms　[04]
　　　　i)　Use of Lagrangian Analysis for a robot manipulator arm
　　　　ii)　Inverse Kinematics and its application

　　b)　For the following Link parameter table given,　[06]

Link	α_{i-1}	a_{i-1}	d_i	θ_i
1	90^0	0	0	0
2	0	20	10	0
3	0	10	0	60^0
4	45^0	0	20	0
5	0	35	0	90^0

Obtain the transformation matrices as given below --

$$[\, ^0_1T\,] , [\, ^1_2T\,] , [\, ^2_3T\,] , [\, ^3_4T\,] , \text{ and } [\, ^4_5T\,]$$

Q.4 a) A trajectory is to be planned for robot joint which is required to reach 60^0 from 30^0 passing through 45^0 taking a total time period of 3 sec. Obtain the cubic polynomial fit and sketch the trajectory (i.e. θ, $d\theta/dt$, $d\theta/dt^2$) **[05]**

b) Discuss in detail the Noise reduction Techniques in Image processing. **[05]**

Q.5 Write a note on **any two** of the following in detail. **[10]**

    i) Artificial Intelligence for Robotics and Techniques of A.I. for Robots

    ii) Development of Robot Programming Languages

    iii) Lead Through Programming Method - manual mode & automatic mode for robotic systems

    iv) Technical parameters for selection of sensors in robotics

    v) Various devices used for Images grabbing

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