Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

SEVENTH SEMESTER B.TECH (INSTRUMENTATION AND CONTROL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: ROBOTIC SYSTEMS AND CONTROL [ICE 425]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.

1A. A joint in space is defined as ${}^{B}P = [2, 3, 5]^{T}$ w.r.t frame 'B'. The origin of Frame 'B' and Frame 'A' share the same origin 'O' and also parallel to each other. Apply the following transformations to frame 'B' and find the new coordinates of the joint w.r.t Frame A, i.e. ${}^{A}P$. **4**

(i) Rotate 90^0 about the OX axis

(ii) Rotate -90^0 about the local OW axis

(iii) Translate 3 units about OY axis, 6 units about the OZ axis and 5 units about OX axis.

1B. Discuss the differences between polar arm and articulated arm configurations. **2**

1C. Given that, for a typical 2-DOF RR Planar Manipulator, the end-effector is moved from (x, y) = (0.5, 0.2) to (0.6, 1.6). Find the initial and final positions of each joints of the manipulator. Consider the length of each link as 1 meter. **4**

2A. For the SCARA type robot shown in figure Q.2A, obtain the DH parameter table and also all transformation matrices. **6**

2B. Discuss about the causes and effects of multiple solutions obtained while solving for inverse kinematic problems. **4**

3A. Given that for a given revoluting joint of a manipulator: **5**

$$\theta_i = 10^0; \quad \theta_f = 45^0; \quad t_i = 0s;$$
$$t_f = 6s; \quad \dot{\theta}_i = \dot{\theta}_f = 0; \quad \left|\ddot{\theta}_i\right| = \left|\ddot{\theta}_f\right| = 5rad/s2$$

Design a suitable trajectory plan for the joint.

3B. Differentiate between: **3**

'*Joint Space Trajectory Planning*' and '*Cartesian Space Trajectory Planning*'.

3C.	Give a brief discussion about wrist singularity and shoulder singularity.	**2**
4A.	Using Langrange method, obtain the equations of motion for a 2R manipulator mounted on ceiling, as shown in Figure: Q4A.	**6**
4B.	List the merits and demerits of Newton Euler formulation.	**4**
5A.	Give a detail account on the various types of encoders using for joint-position measurement in robot manipulators.	**4**
5B.	Explain the various classifications of mechanical grippers used in robotic manipulators.	**6**
6A.	Give a detail account on Hybrid Impedance control.	**5**
6B.	List the merits and demerits of Electric Servomotors and Hydraulic Servomotors.	**5**

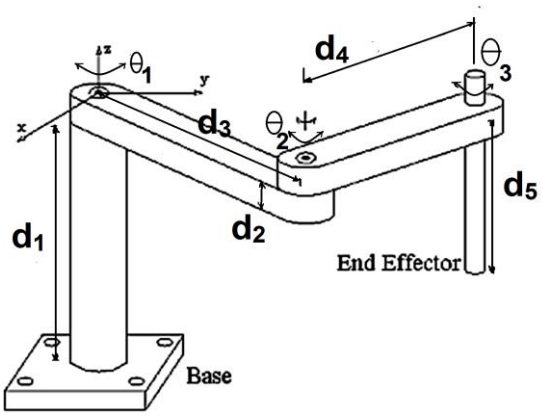

Fig: Q.2A

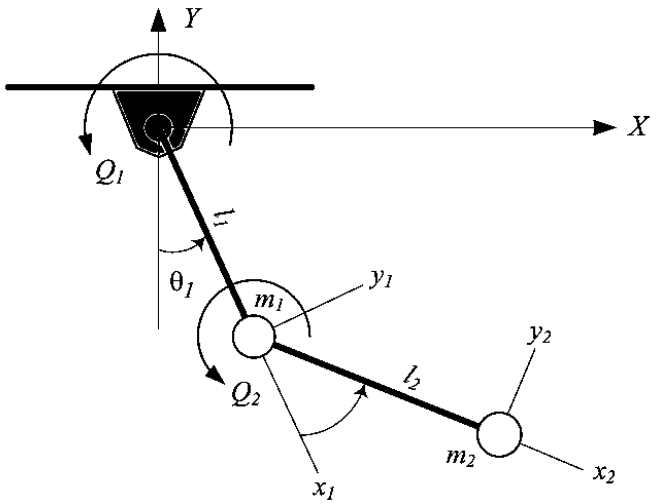

Fig: Q.4A