BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M.Tech **SEMESTER : II**
BRANCH: AMS **SESSION : SP/19**

SUBJECT: PE510 ROBOTICS AND ROBOT APPLICATION

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Describe the five basic robot configurations. [5]

Q.1(b) Discuss the four type of power sources used in robot and compare their advantages and disadvantages according to economics, reliability, and load-carrying ability. [5]

Q.2(a) Explain the different types of mechanism used in mechanical gripper [5]

Q.2(b) Describe the four different types of photoelectric sensors. [5]

Q.3(a) Fig. a shows a 2-DOF planar elbow-arm, sometimes called as R-R manipulator. The non-zero link and joint parameters are: $a_1 = 6$, $a_2 = 9$, $\theta_1 = 60°$ and $\theta_2 = 45°$. Obtain the transformation matrices and find the solution for the direct kinematics problem. [5]

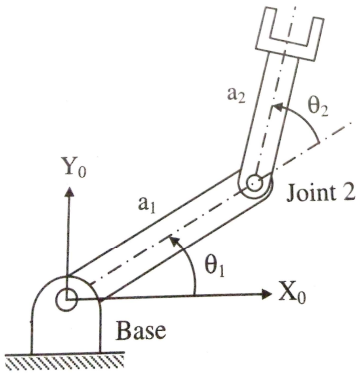

Fig. a

Q.3(b) The position and orientation of a robot arm is represented by the matrix [5]

$$\begin{vmatrix} 0.527 & -0.574 & 0.628 & 6 \\ 0.369 & 0.819 & 0.439 & 4 \\ -0.766 & 0 & 0.643 & 6 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

has been moved 6 units along the x-axis and 4 units along z-axis. Find the final position and orientation of the robot arm.

Q.4(a) D-H parameters of R-P-R arm are given in table below. Obtain the Jacobian matrix relating the velocity of end-effector with joint velocities $[\dot{\theta}_1 \;\; \dot{d}_2 \;\; \dot{\theta}_3]^T$. If $\theta_1 = 30°$, $d_2 = 0.5$ m and $\theta_3 = -75°$, what are linear and angular velocity of end-effector. Given joint actuation speeds as: 10°/sec, 0.3m/sec and -3.5°/sec respectively. [5]

Link	d	a	α	θ
1	0.5	0	90°	θ_1
2	d_2	1	0	0
3	0	0.2	90°	θ_3

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Q.4(b) Describe the Lagrangian formulation of manipulator dynamics. [5]

Q.5(a) In a pallet object 40 mm height are located in a number of rows and columns. The pallet has three rows that are 30 mm apart and 4 columns that are 50 mm apart. The plane of the pallet is assumed to parallel to x-y plane. The objects are to be picked up one after another from the pallet and placed in a location chute. Write VAL program for this operation. [5]

Q.5(b) Explain the selection criteria and advantage of using robot in the following manufacturing operations: [5]

I. Machining
II. Welding
III. Assembly

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