

Time: 3 Hour

Max. Marks: 80

N. B.

- 1) Question No.1 is compulsory.
- 2) Attempt any three questions from remaining five questions
- 3) All questions carry equal marks
- 4) Figures to the right indicate full marks.

- Q1.** Attempt any **FOUR** of the followings: **(20)**
- a) Explain the transformation matrix in robotics.
 - b) Explain and illustrate the D-H representation of link and joint parameters for a serial manipulator as shown in Fig.1.

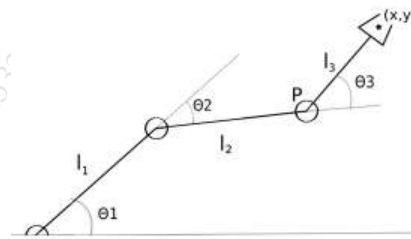


Fig.1. Serial Manipulator

- c) Explain the significant difference between soft and hard automation..
 - d) What is tactile sensors?
 - e) State and explain specifications of the Robot.
- Q2.**
- a) Identify joints and find degree of freedom of a serial manipulator as shown in Fig.1. Also find the transformation matrix of the end effector with respect to base. **(10)**
 - b) Explain the trajectory planning using the cubical trajectory function. **(10)**
- Q3.**
- a) For a serial manipulator shown in Fig. 1, find the inverse joint angles using inverse kinematics analysis, assuming the end effector position as x and y. **(12)**
 - b) State the principles of the materials handling system. Explain the role of materials handling system in storage. **(8)**
- Q4.**
- a) What is segmentation in Machine Vision. Explain thresholding method used for converting grey scale image into binary black-and-white image. **(7)**
 - b) Explain the degree of freedom of mobile robot. **(7)**
 - c) Explain the principle of robot task planning. **(6)**
- Q5.**
- a) Explain construction, working principle, and applications of range sensor. **(8)**
 - b) Explain social and economic issues in employing robots. **(8)**
 - c) Explain robot dynamics with help of robot as shown in figure 1. **(4)**
- Q6.** Write a short notes on the followings (**ANY FOUR**) **(20)**
- a) Position and velocity sensors.
 - b) Edge detection
 - c) Robot languages
 - d) End effectors in robots
 - e) Robot cell design and control.