Laboratory work 1. GEOMETRY OF THE ROBOT MANIPULATORS

1.Draw the kinematic structures of the robot manipulators shown in Fig.1.

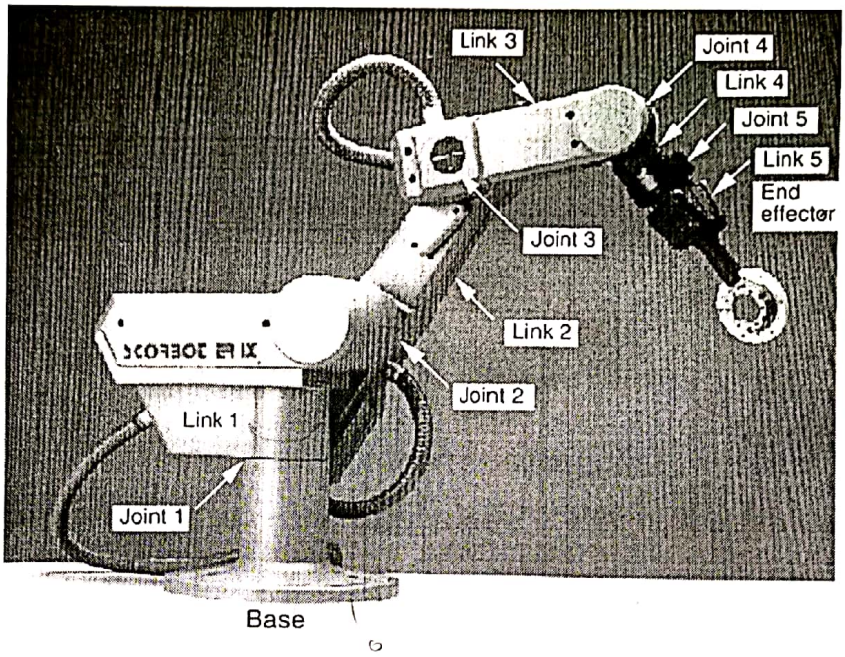

Fig.1.1. Scorbot robot

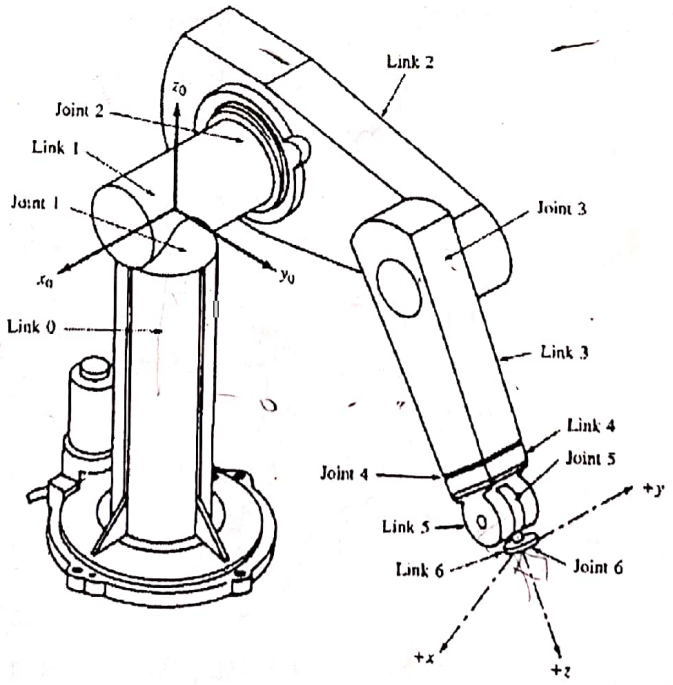

Fig.1.2. PUMA robot

2. Find the number of degrees of freedom of the robot manipulators shown in Fig.2.

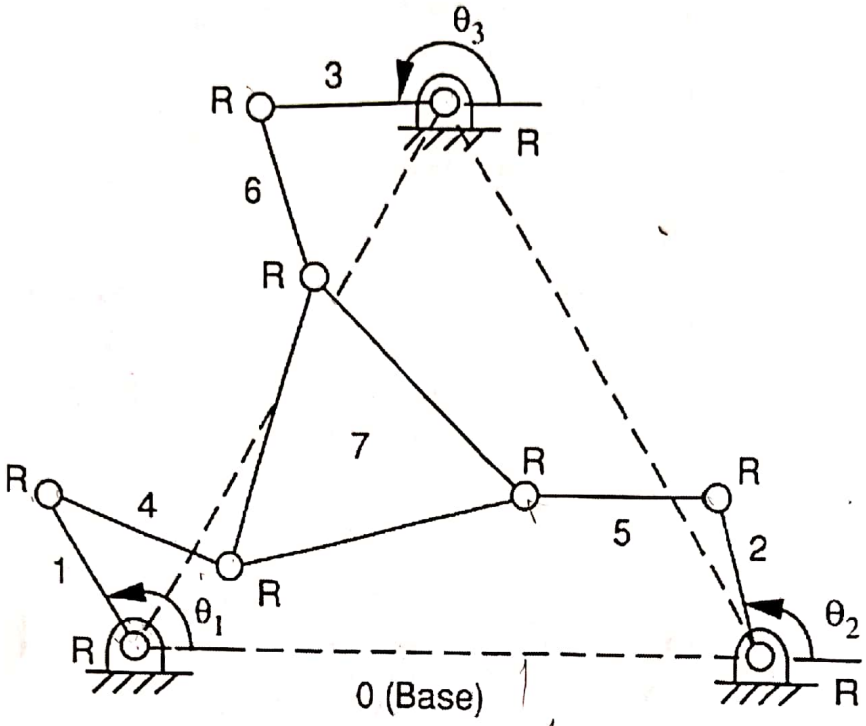

Fig.2.1. Planar 3RRR robot manipulator

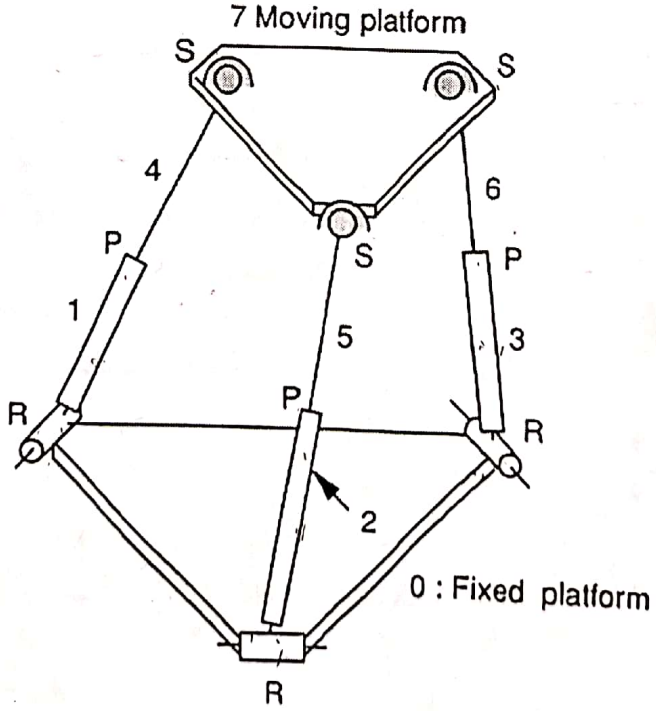

Fig.2.2. Spatial 3RPS robot manipulator

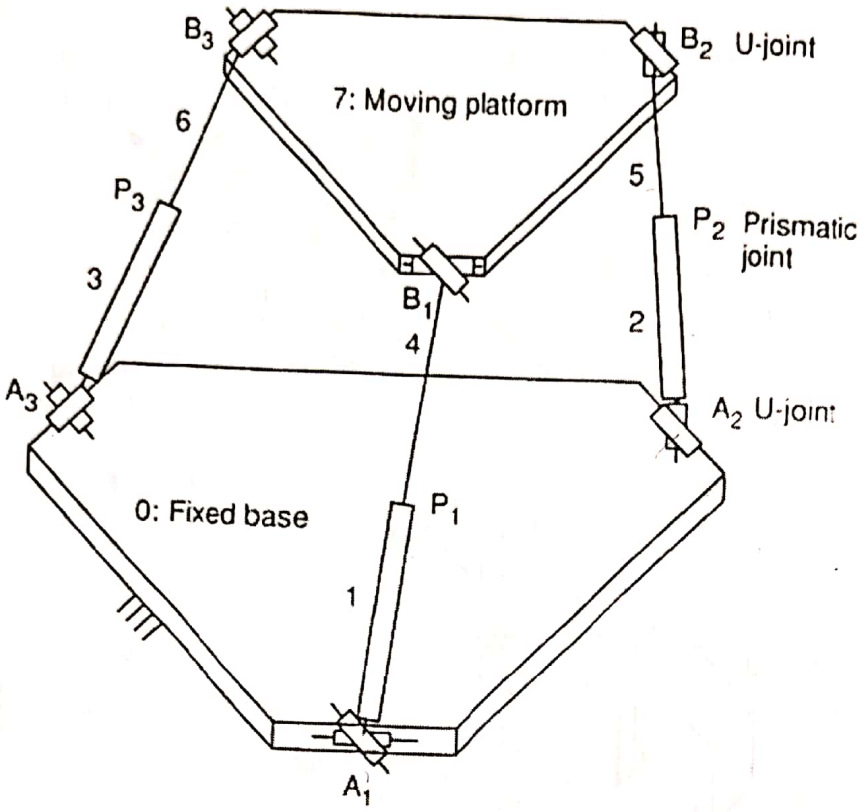

Fig.2.3. Spatial 3UPU robot manipulator

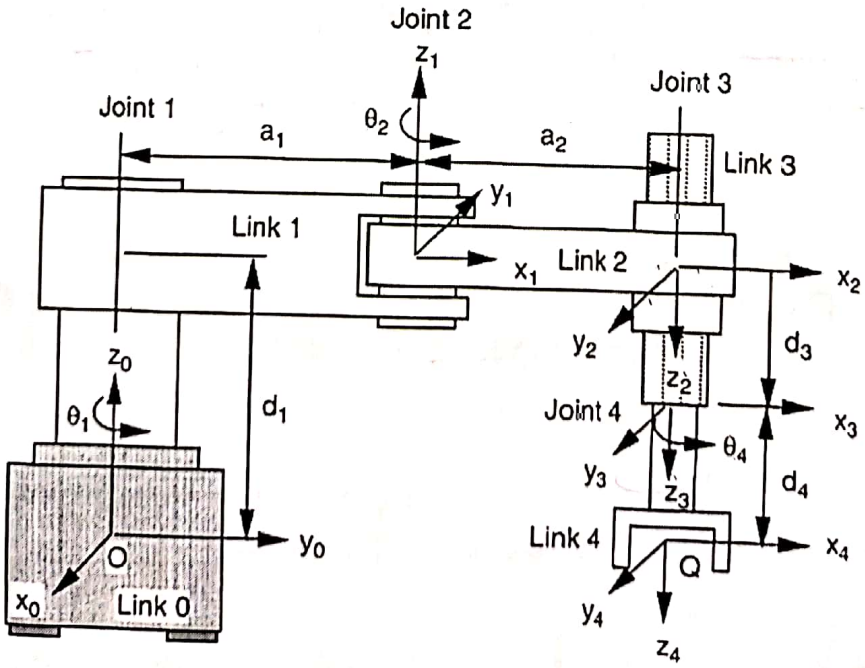

Fig.2.4. SCARA robot manipulator

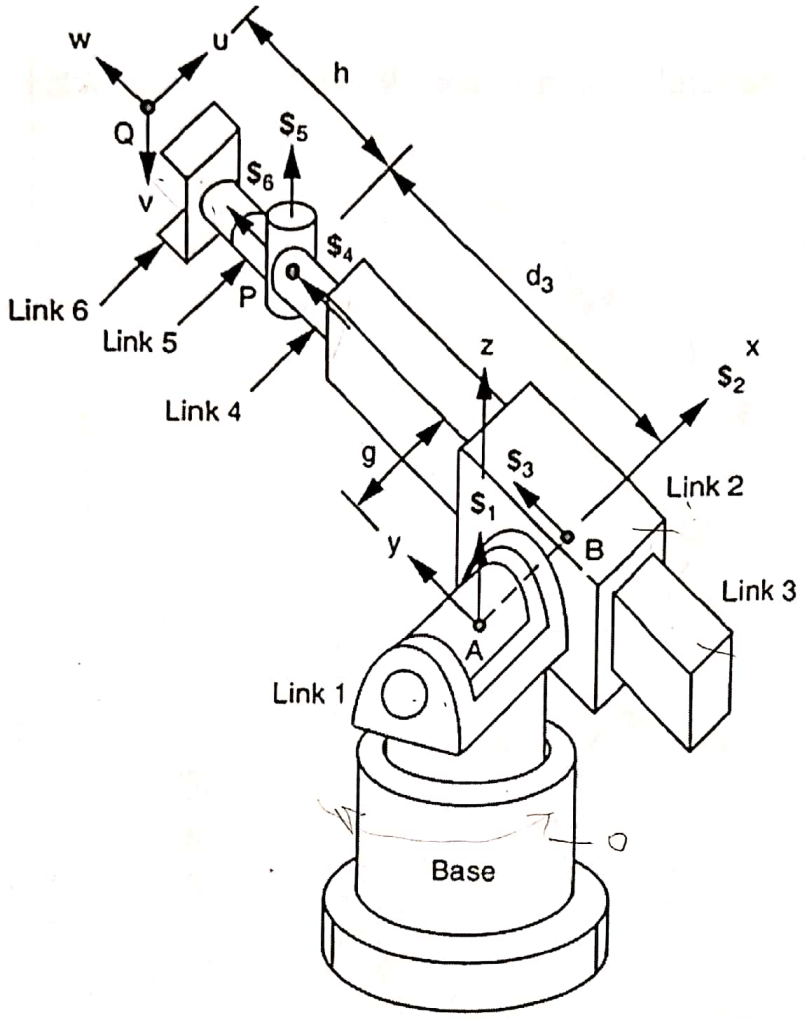

Fig.2.5. Stanford robot manipulator

Laboratory work 2. DIRECT KINEMATICS OF THE SERIAL MANIPULATOR

Solve the direct kinematics of the 3R planar manipulator shown in Fig.1.

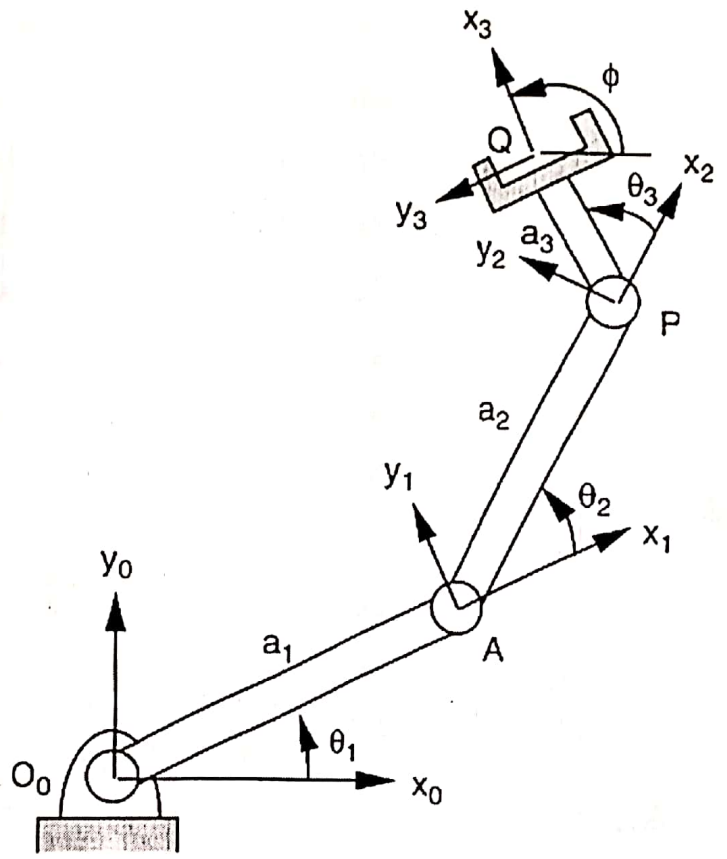

Fig.1. 3R planar manipulator

Table 1

№	Lengths of links		
	a_1	a_2	a_3
1	40	40	20
2	42	42	21
3	44	44	22
4	46	46	23
5	48	48	24
6	50	50	25
7	52	52	26
8	54	54	27
9	56	56	28
10	58	58	29
11	60	60	30
12	62	62	31
13	64	64	32
14	66	66	33
15	68	68	34
16	70	70	35
17	72	72	36
18	74	74	37

Laboratory work 3. INVERSE KINEMATICS OF THE PLANAR SERIAL MANIPULATOR

Solve the inverse kinematics of the $3R$ planar manipulator shown in Fig.1.

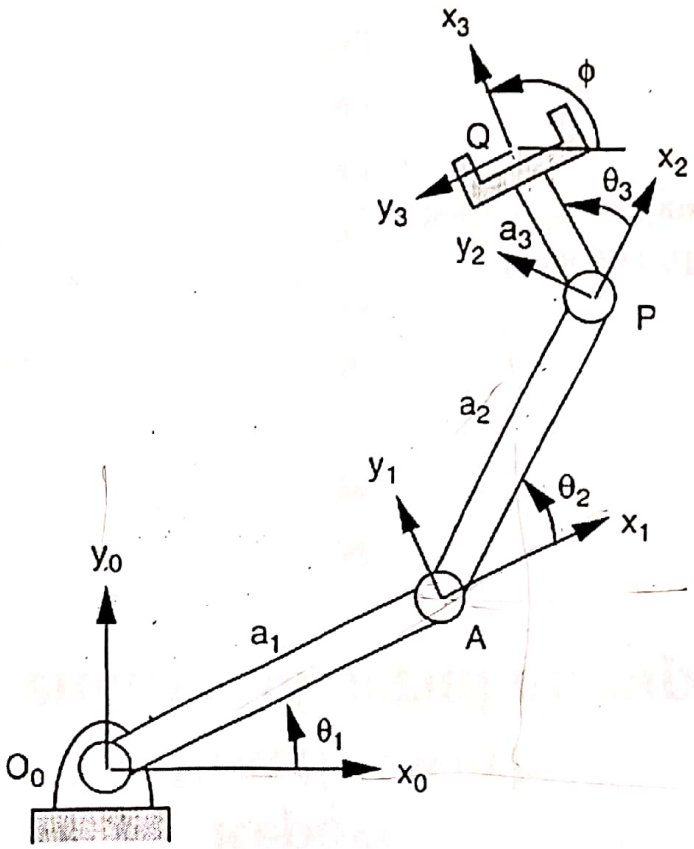

Fig.1. $3R$ planar manipulator

Table 1

№	Lengths of links		
	a_1	a_2	a_3
1	40	40	20
2	42	42	21
3	44	44	22
4	46	46	23
5	48	48	24
6	50	50	25
7	52	52	26
8	54	54	27
9	56	56	28
10	58	58	29
11	60	60	30
12	62	62	31
13	64	64	32
14	66	66	33
15	68	68	34
16	70	70	35
17	72	72	36
18	74	74	37

Laboratory work 4. DIRECT KINEMATICS OF THE SPATIAL SERIAL MANIPULATOR

Solve the direct kinematics of the Scorbot Robot shown in Fig.1

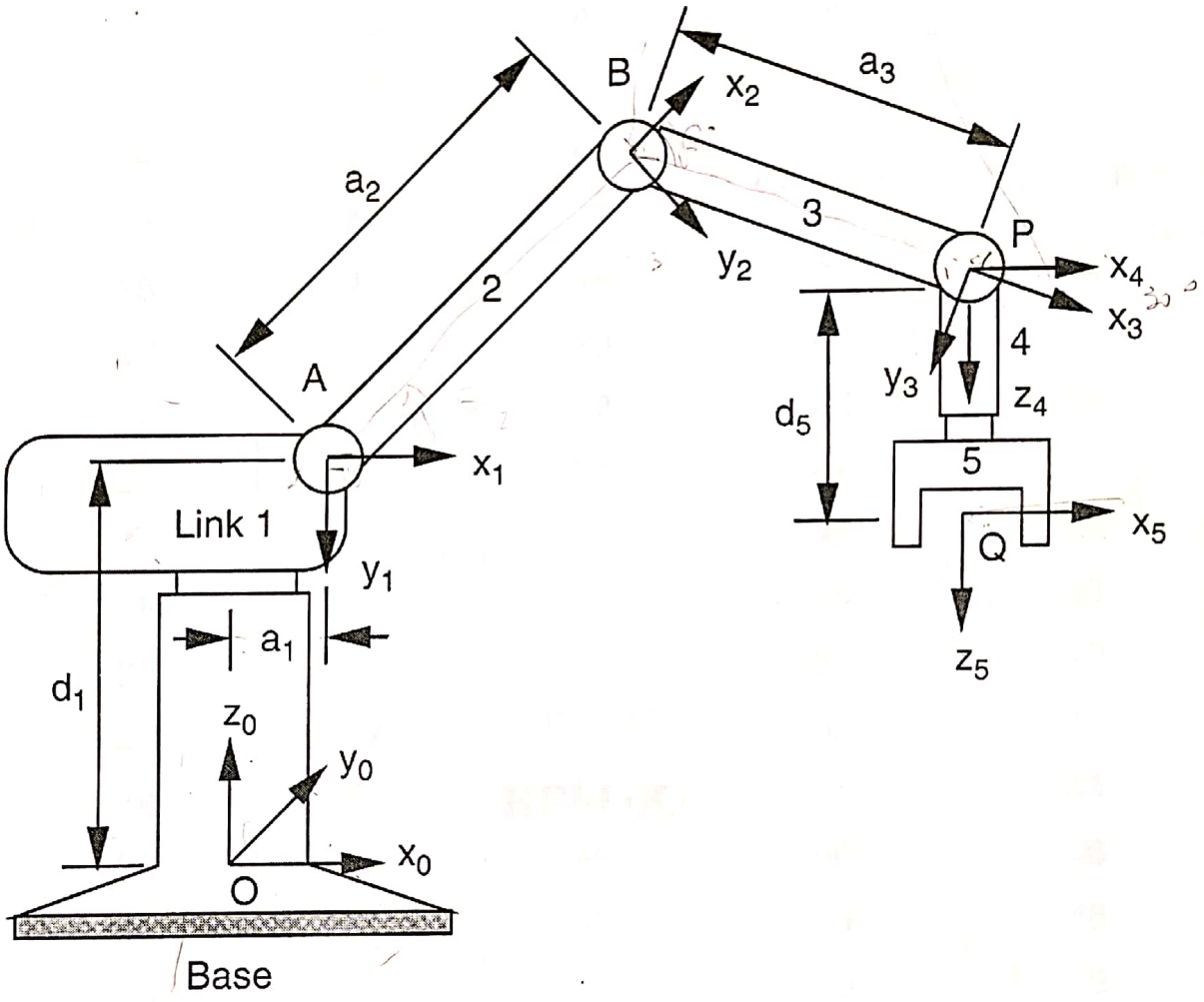

Fig.1. Kinematic structure of the Scorbot Robot

Table 1

№	Constant D-H parameters				
	a_1	d_1	a_2	a_3	d_5
1	10	35	40	30	20
2	12	37	42	32	22
3	14	39	44	34	24
4	16	41	46	36	26
5	18	43	48	38	28
6	20	45	50	40	30
7	22	47	52	42	32
8	24	49	54	44	34
9	26	51	56	46	36
10	28	53	58	48	38
11	30	55	60	50	40
12	32	57	62	52	42
13	34	59	64	54	44
14	36	61	66	56	46
15	38	63	68	58	48
16	40	65	70	60	50
17	42	67	72	62	52
18	44	69	74	64	54

Laboratory work 5. INVERSE KINEMATICS OF THE SPATIAL SERIAL MANIPULATOR

Solve the inverse kinematics of the Scorbot Robot shown in Fig.1

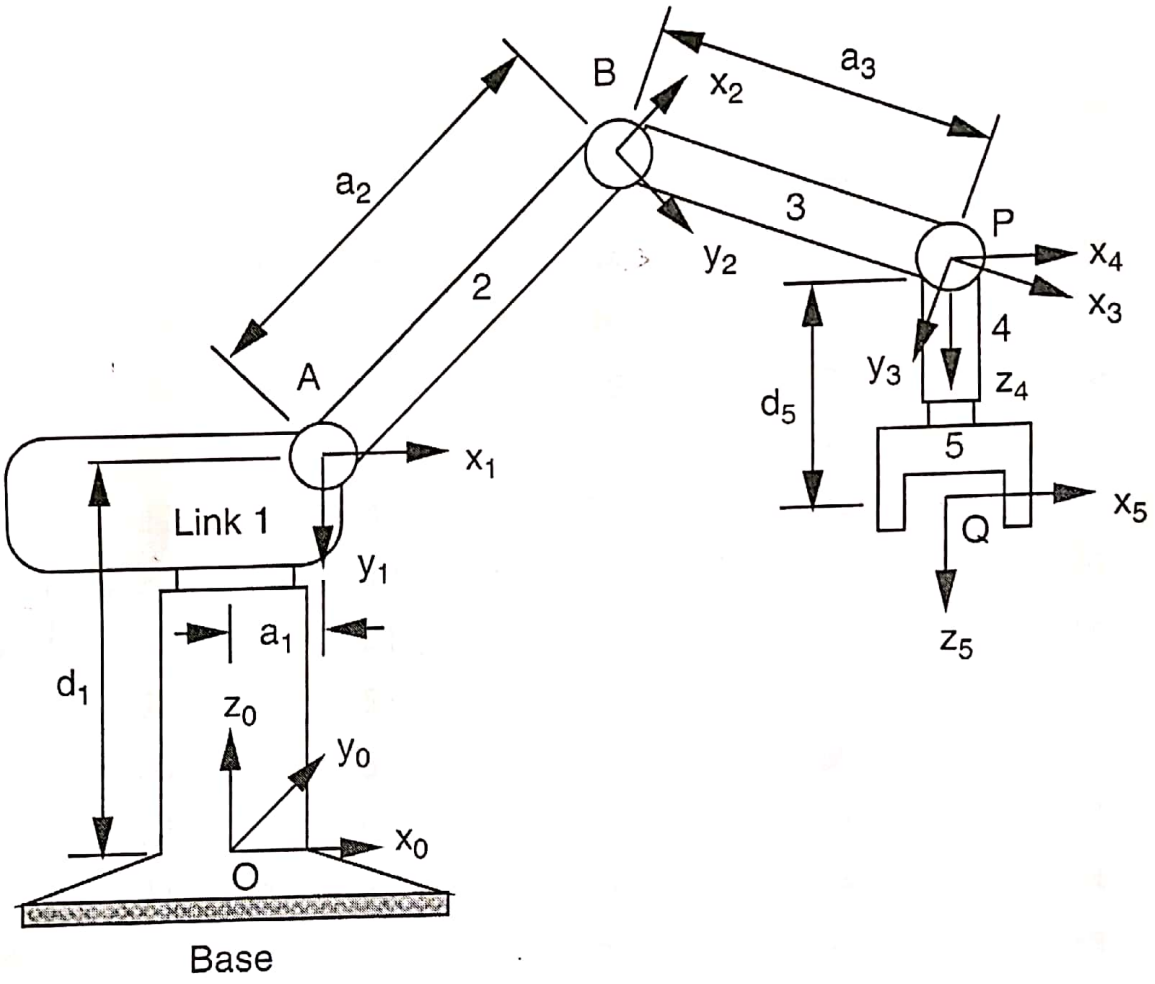

Fig.1. Kinematic structure of the Scorbot Robot

Table 1

№	Constant D-H parameters				
	a_1	d_1	a_2	a_3	d_5
1	10	35	40	30	20
2	12	37	42	32	22
3	14	39	44	34	24
4	16	41	46	36	26
5	18	43	48	38	28
6	20	45	50	40	30
7	22	47	52	42	32
8	24	49	54	44	34
9	26	51	56	46	36
10	28	53	58	48	38
11	30	55	60	50	40
12	32	57	62	52	42
13	34	59	64	54	44
14	36	61	66	56	46
15	38	63	68	58	48
16	40	65	70	60	50
17	42	67	72	62	52
18	44	69	74	64	54

Laboratory work 6. DIRECT KINEMATICS OF THE PLANAR PARALLEL MANIPULATOR

Solve the direct kinematics of the $3RRR$ planar parallel manipulator shown in Fig.1

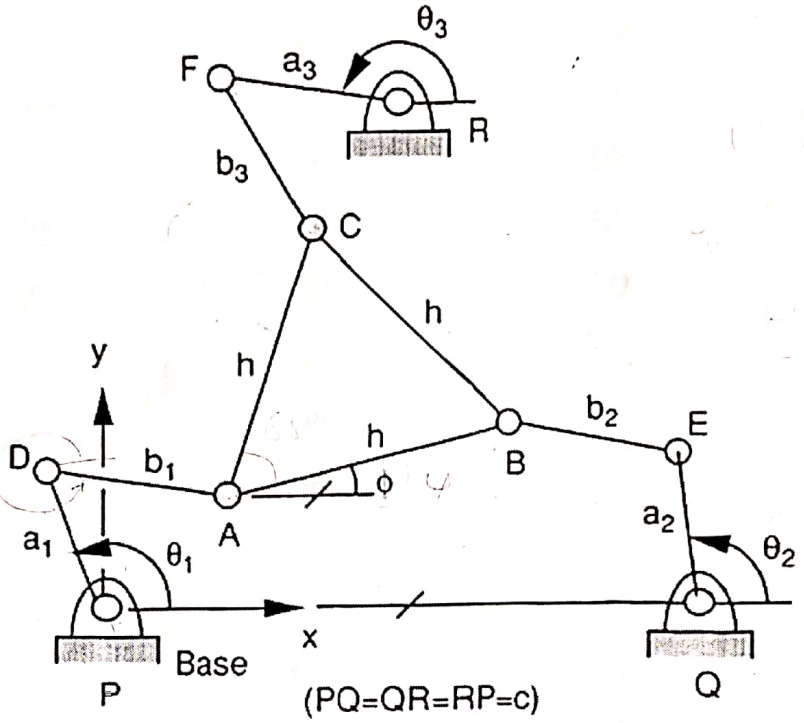

Fig.1. Kinematic structure of the $3RRR$ planar parallel manipulator

Table 1

№	Lengths of links			
	a	*b*	*c*	*h*
1	15	20	60	30
2	17	22	62	32
3	19	24	64	34
4	21	26	66	36
5	23	28	68	38
6	25	30	70	40
7	27	32	72	42
8	29	34	74	44
9	31	36	76	46
10	33	38	78	48
11	35	40	80	50
12	37	42	82	52
13	39	44	84	54
14	41	46	86	56
15	43	48	88	58
16	45	50	90	60
17	47	52	92	62
18				

Laboratory work 7. INVERSE KINEMATICS OF THE PLANAR PARALLEL MANIPULATOR

Solve the inverse kinematics of the $3RRR$ planar parallel manipulator shown in Fig.1

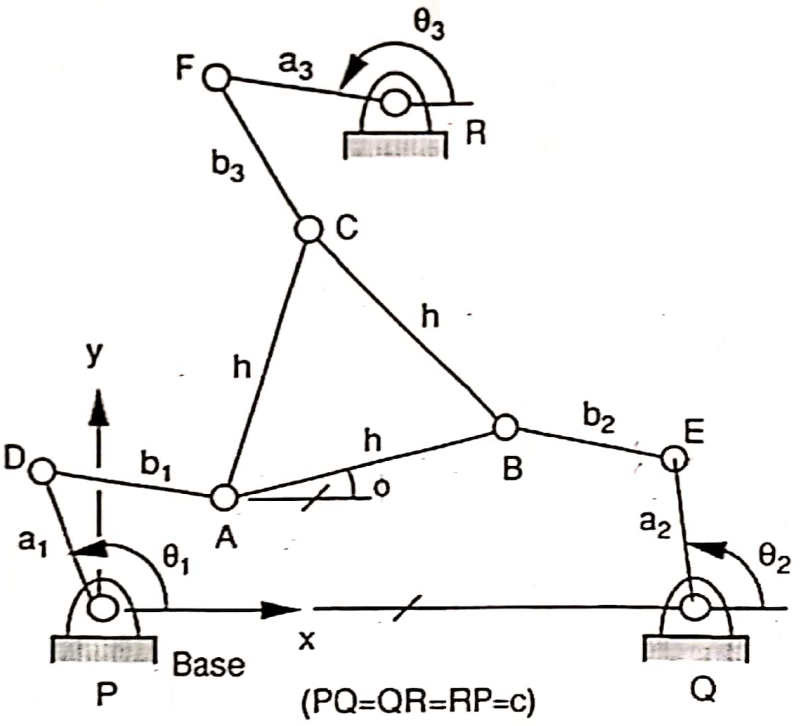

Fig.1. Kinematic structure of the $3RRR$ planar parallel manipulator

Table 1

№	Lengths of links			
	a	*b*	*c*	*h*
1	15	20	60	30
2	17	22	62	32
3	19	24	64	34
4	21	26	66	36
5	23	28	68	38
6	25	30	70	40
7	27	32	72	42
8	29	34	74	44
9	31	36	76	46
10	33	38	78	48
11	35	40	80	50
12	37	42	82	52
13	39	44	84	54
14	41	46	86	56
15	43	48	88	58
16	45	50	90	60
17	47	52	92	62
18	49	54	94	64