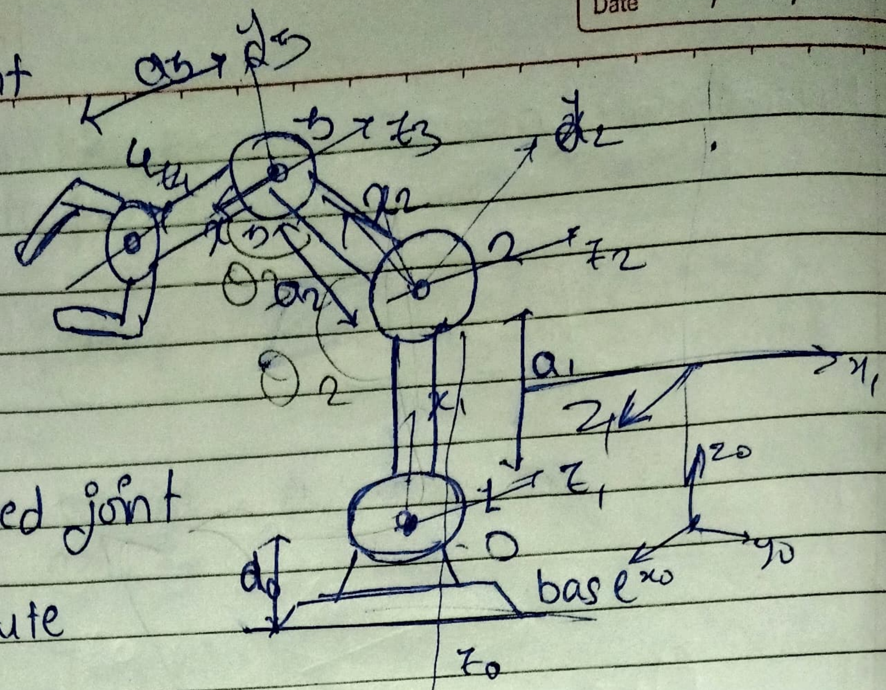
Assignment

Q.1



base = fixed joint
1, 2, 3 are all Revolute Joints

No. of Joints: So in all there are 5 Joints.

Types of Joints: Base joint is fixed
1, 2, 3, 4 are all revolute joints

D.o.F: There are 4 D. of F.

D.H Parameters:

i	α_{i-1}	a_{i-1}	d_i	θ_i
1	90°	a_0	0	90°
2	0	a_1	0	θ_2
3	0	a_2	0	θ_3
4	0	a_3	0	θ_4

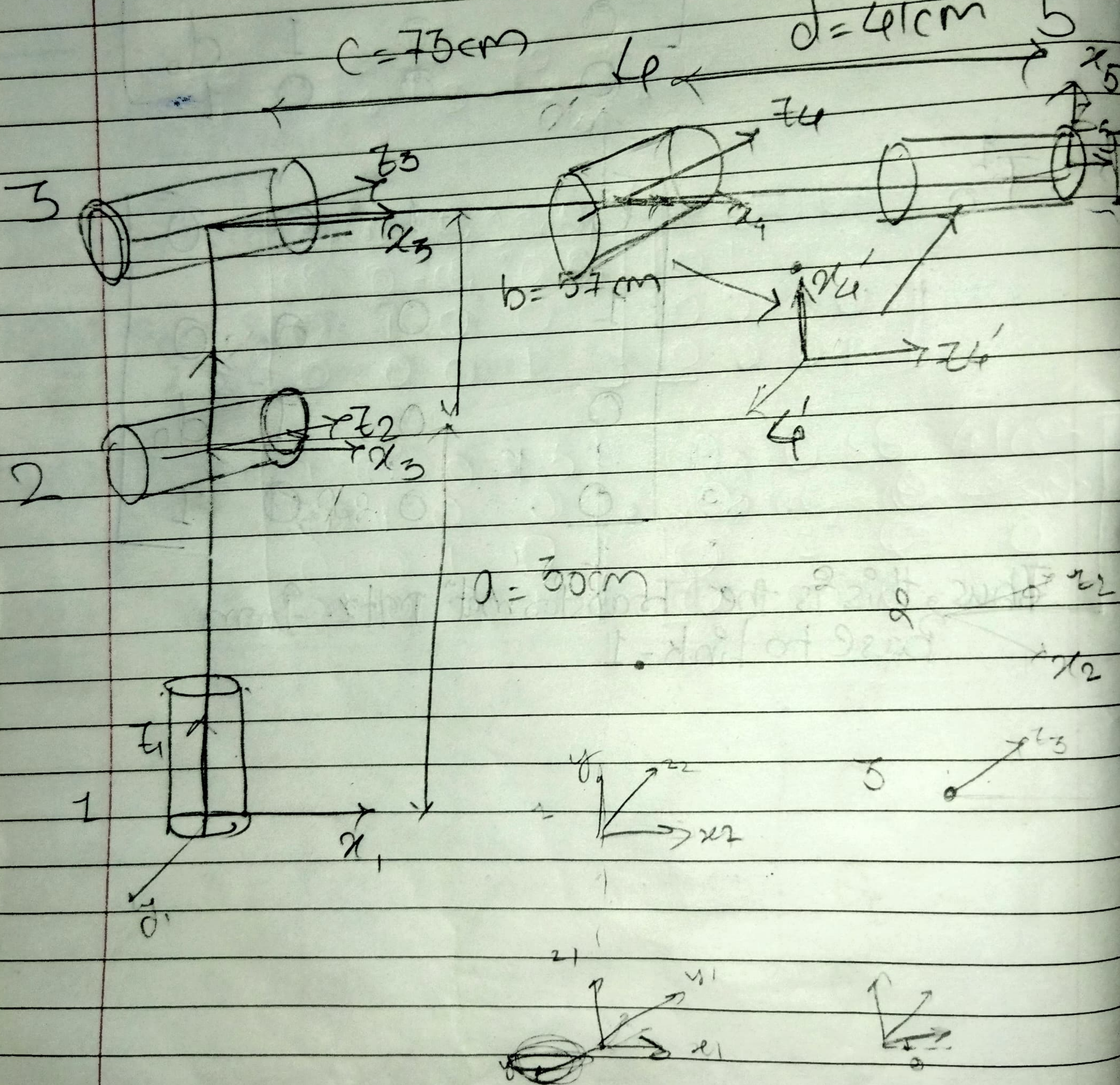
Transformation Mtx for Fixed to 1

So,
$$T_0^1 = \begin{bmatrix} \cos\theta_1 & -\sin\theta_1 & 0 & 0 \\ \sin\theta_1 & \cos\theta_1 & 0 & 0 \\ 0 & 0 & 1 & d_0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\therefore T_0^1 = \begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & d_0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Thus, this is the Transformatⁿ Mtx. from Base to Link-1

Q2 For the foll. Robotic arm diagram, Find the DH parameters & Final Transformation Mtx thr. Forward Kinematics.



i	α_{i-1}	a_{i-1}	d_i	θ_i
1	–	–	–	–
2	90	30	0	θ_1
3	0	57	0	0
4	0	73	0	0
5	90	41	0	θ_2

Transformation Mtx

$$T_1^2 = \begin{bmatrix} c\theta_1 & 0 & s\theta_1 & 30\cos\theta_1 \\ s\theta_1 & 0 & -c\theta_1 & 30\sin\theta_1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_2^3 = \begin{bmatrix} 1 & 0 & 0 & 57 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_3^4 = \begin{bmatrix} 1 & 0 & 0 & 73 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$\alpha = 90, \ \theta = \theta_2$

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$$T^5_4 = \begin{bmatrix} c\theta_2 & 0 & s\theta_2 & 41c\theta_2 \\ s\theta_2 & c\theta_2 & -c\theta_2 & 41s\theta_2 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\therefore T^5_1 = T^5_4 \cdot T^4_3 \cdot T^3_2 \cdot T^2_1$$

$$= \begin{bmatrix} c\theta_1 & 0 & s\theta_1 & 30c\theta_1 \\ s\theta_1 & 0 & -c\theta_1 & 30s\theta_1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 57 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot$$

$$\begin{bmatrix} 1 & 0 & 0 & 73 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} c\theta_2 & 0 & s\theta_2 & 41c\theta_2 \\ s\theta_2 & c\theta_2 & -c\theta_2 & 41s\theta_2 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$