



3. Given a matrix  ${}^{i-1}T_i$  ( $i=1, 2, 3, \dots, 6$ ), explain how to find the information about the angle between  $\hat{Z}_0$  and  $\hat{Z}_2$ . [20]

**Part III (60 marks total)**

Figure 1 (the next page) shows a robot manipulator whose structure and geometry are supposed to be known.

1. Set up (with a proper explanation) a coordinate system for each body of the manipulator based on the D-H notation (do the work on the figure directly). [20]
2. Fill in the first row ( $i=1$ ) in the following table. [15]
3. Write out the transformation matrix  ${}^0T_1$ . [10]
4. Write out the origin of the frame 1 with respect to the frame 0. [15]

I	$\alpha_{i-1}$	$a_{i-1}$	$d_i$	$\theta_i$

The general transformation matrix is given below:

$${}_{i-1}T_i = \begin{bmatrix} c\theta_i & -s\theta_i & 0 & a_{i-1} \\ s\theta_i c\alpha_{i-1} & c\theta_i c\alpha_{i-1} & -s\alpha_{i-1} & -s\alpha_{i-1}d_i \\ s\theta_i s\alpha_{i-1} & c\theta_i s\alpha_{i-1} & c\alpha_{i-1} & c\alpha_{i-1}d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

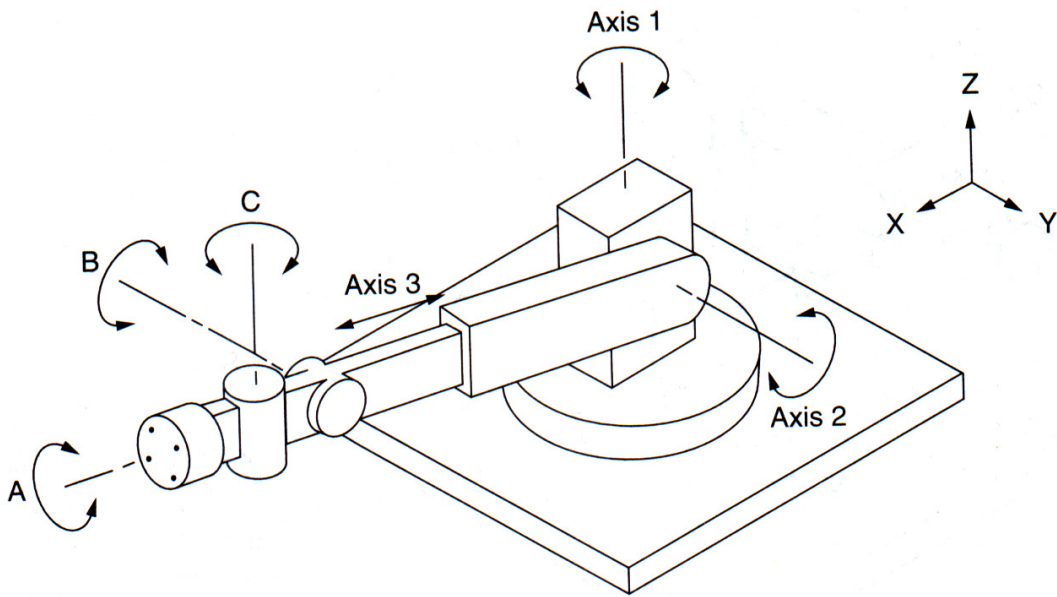


Figure 1

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