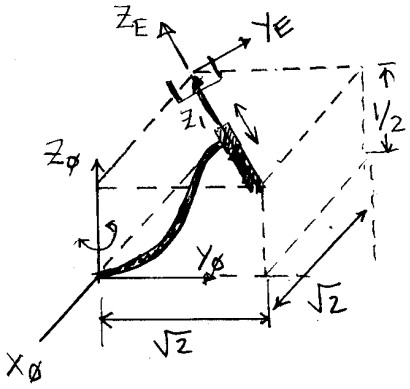
MCH5209 / ME5402: Robotics Quiz 2 25 January 2000

Name:_____ Matric number:_____

The figure shows a robot with two joints. The first moving link rotates about Z_0 and the 2nd link translates along Z_1. Frame 0 serves as the base frame with its z axis, Z_0, coinciding with the axis of the first joint. Frame E is attached to the end-effector (link 2) as shown. The z axis of the end-effector, Z_E is along the length of the link and is aligned with the joint axis of the 2nd link, Z_1, as shown in the Figure. Note that Z_1 is on a plane (horizontal plane in the figure) that is normal to Z_0.

1. Assign frames to each of the two links according to the Denavit-Hartenberg (D-H) convention discussed in class. Draw the frames on the figure itself.



yz Plane of Frame E is always parallel to xy plane of Frame Ø.

2. Determine the 4 kinematic parameters (D-H parameters) that define the relative position and orientation of each link. Indicate which of the parameter is the joint variable. Put your answer in the following table.

Link	θ	r	d	α	Joint Variable
1					
2					

3. Determine the 4x4 homogeneous transformation matrix that determines the position and orientation of Frame E with respect to Frame 2 (Frame 2 was assigned using the D-H convention).

Ans: ${}^2T_E$ =

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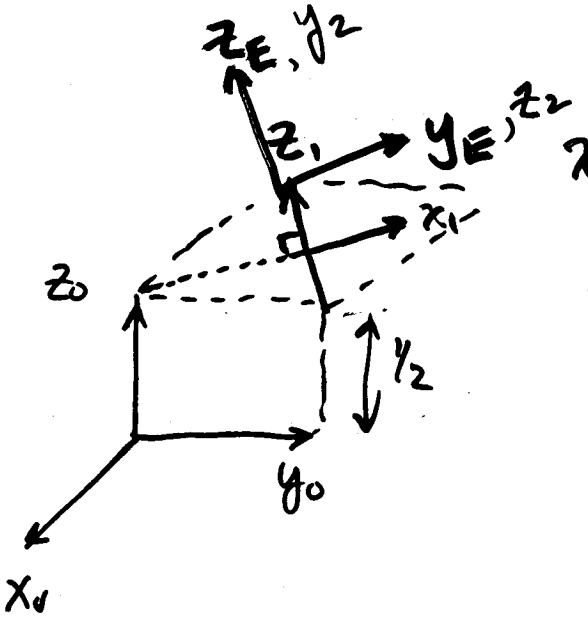
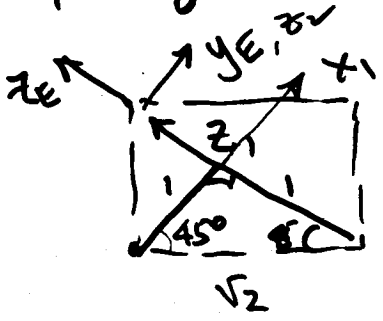
1.



$x_1 \parallel y_E$

z_1 aligned with z_E



2.

	θ	r	d	α	Joint Variable
1	135°	$\frac{1}{2}$	1	$-90°$	θ
2	90°	1	0	90°	r

3. $${}^2T_E = \begin{pmatrix} {}^2x_E & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ & 0 & 1 & 0 \\ & & & 1 \end{pmatrix}$$

$= {}^2y_E \times {}^2z_E$