CSCE 452 Quiz #3 – Inverse Kinematics

Name:_________________  UIN:_______  _______________

For the RRP robot in the figure, Vector $^0(x_3, y_3, \alpha_3)$ which represents the end effector position and orientation is given. We need you to

1) Attach frames {1}, {2}, and {3} to the robot by drawing X and Z vectors on the figure.

2) Draw $\theta_1, \theta_2,$ and $d_3$ on the figure. Make sure the positive rotation directions of $\theta$’s are correct.

3) What is $(\theta_1, \theta_2, d_3)$ in terms of $^0(x_3, y_3, \alpha_3)$? Note that the first link length is $L_1$ and the last link is perpendicular to the second link.

\[
L_1 \sin(\theta_1) + d_3 \sin \rho = y_3 \\
L_1 \cos(\theta_1) + d_3 \cos \rho = x_3 \\
\theta_2 + \phi = \frac{\pi}{2}, \quad \theta_1 = \rho + \phi, \quad \rho = \alpha_3 - \frac{\pi}{2}
\]
\[
\cos(\pi - \phi) = \frac{L_1^2 + d_3^2 - x_3^2 - y_3^2}{2L_1d_3}
\]