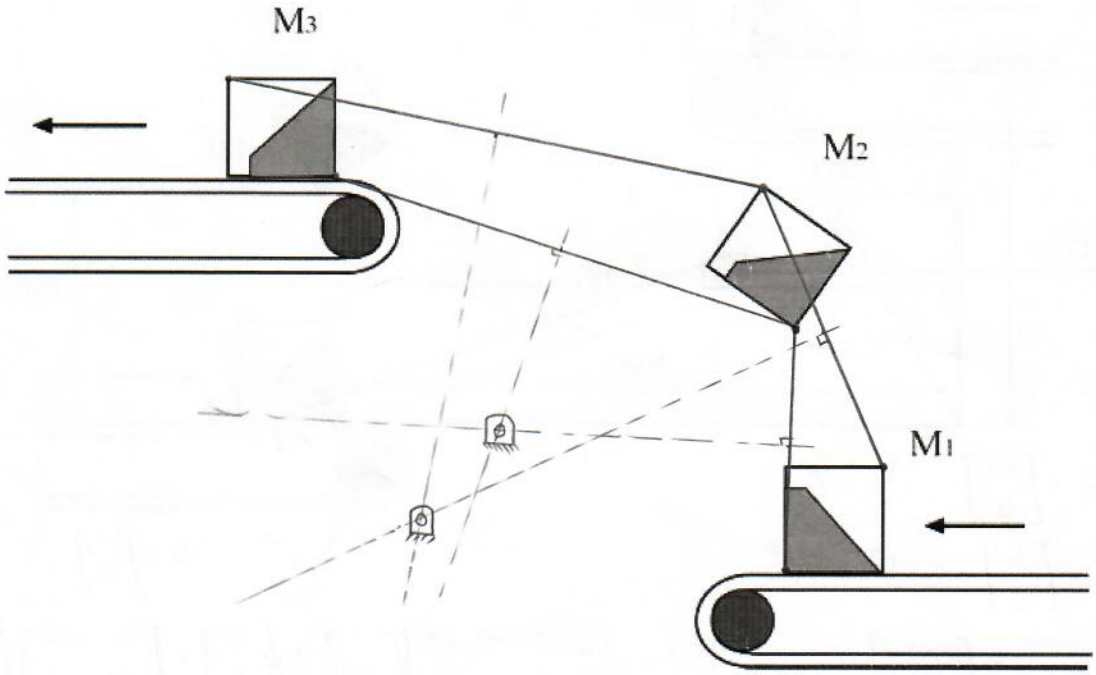
ME 3320 Quiz #2

1. **(40 points) Graphical synthesis in the plane:** Design a four-bar linkage to move the object through the three positions shown in the figure. Pick moving pivot A in the dark corner and moving pivot B in the opposite corner.

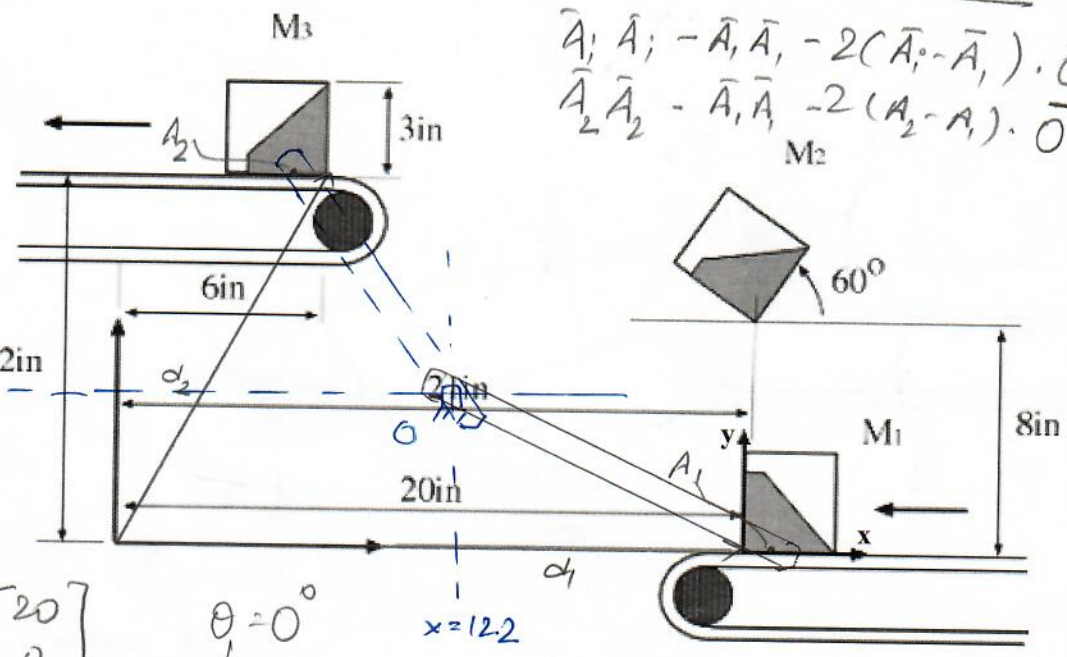


2. **(60 points) Algebraic synthesis in the plane**: Design one RR chain (ONLY ONE) to move the block from position 1 (M1) to position 3 (M3) (Consider **only two positions**, M1 and M3). Select moving pivot **a** = (1,0) (with respect to the moving frame depicted in Position 1).

2 position Synthesis: 1 design equation

$\bar{A}_1 \bar{A}_1 - \bar{A}_1 \bar{A}_1 - 2(\bar{A}_1 - \bar{A}_1)\cdot\bar{O} = 0$

$\bar{A}_2 \bar{A}_2 - \bar{A}_1 \bar{A}_1 - 2(\bar{A}_2 - \bar{A}_1)\cdot\bar{O} = 0$



Pos 1, 2

y = 5

x = 12.2

$d_1 = \begin{bmatrix} 20 \\ 0 \end{bmatrix}$ $\theta_1 = 0°$

$d_2 = \begin{bmatrix} 6 \\ 12 \end{bmatrix}$ $\theta_2 = 90°$

$a = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$\bar{A}_1 = d_1 + [R(\theta_1)]\,a = \begin{bmatrix} 20 \\ 0 \end{bmatrix} + \begin{bmatrix} \cos 0 & -\sin 0 \\ \sin 0 & \cos 0 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 20 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 21 \\ 0 \end{bmatrix}$

$\bar{A}_2 = d_2 + [R(\theta_2)]\,a = \begin{bmatrix} 6 \\ 12 \end{bmatrix} + \begin{bmatrix} \cos 90° & -\sin 90° \\ \sin 90° & \cos 90° \end{bmatrix}\begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 6 \\ 12 \end{bmatrix} + \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 6 \\ 12 \end{bmatrix}$

$\bar{A}_2 \cdot \bar{A}_2 - \bar{A}_1 \cdot \bar{A}_1 - 2(\bar{A}_2 - \bar{A}_1)\cdot\bar{O} = 0$

$O = \begin{bmatrix} O_x \\ O_y \end{bmatrix}$

$(6\times 6 + 13\cdot 13) - (21\times 21 + 0\cdot 0) - 2\left(\begin{bmatrix} 6 \\ 13 \end{bmatrix} - \begin{bmatrix} 21 \\ 0 \end{bmatrix}\right)\cdot\begin{bmatrix} O_x \\ O_y \end{bmatrix} = 0$

$36 + 169 - 441 - 2\begin{bmatrix} -15 \\ 13 \end{bmatrix}\begin{bmatrix} O_x \\ O_y \end{bmatrix} = 0$

Assume $O_y = 5$

$-150_x + 13O_y = -118$

$-15O_x + 13\times 5 = -118$

$\therefore O_x = 12.2$