PARMAR Akashkumar Prakashchandra 118737430

1.1 :-

Given data =>

Initial position = (x_i, y_i, ϕ_i)

Diameter $(d) = 0.5 m$ => Radius$(r) = 0.25 m$

Length $(L) = 4 m$

None of the wheel slips.

For finding out the x, y and ϕ positions of point o, we need to find out drive speed ω.

Here, the drive speed of point O will be equal to drive speed of center point of the rear axle. which will be average of ω_{left} & ω_{Right}

$\omega_{left} + \omega_{right} = 2\omega$ given.

$$\omega_{avg.} = \frac{\omega_{left} + \omega_{right}}{2} = \frac{2\omega}{2} = \boxed{\omega}$$

From the geometry, it is evident that $\theta = \phi + 90°$

$$\dot{\theta} = \frac{u_s}{L} \tan\alpha$$

Here, $u_s = r\omega$

$$\dot{\theta} = \frac{r\omega}{L} \tan\alpha$$

$\theta = (\frac{r\omega}{L} \tan\alpha)t + c$, where $c = \theta_i = \phi_i + 90$

$$\dot{x} = v_s \cos\theta$$

$$\dot{x} = v_s \cos\left(\left(\frac{r\omega}{L}\tan d\right)t + \theta_i\right)$$

$$x = \frac{v_s \sin\left(\left(\frac{r\omega}{L}\tan d\right)t + \theta_i\right)}{\frac{r\omega}{L}\tan d} + C_x$$

$$\dot{y} = v_s \cos\theta$$

$$\dot{y} = v_s \sin\left(\left(\frac{r\omega}{L}\tan d\right)t + \theta_i\right)$$

$$y = \frac{-v_s \cos\left(\left(\frac{r\omega}{L}\tan d\right)t + \theta_i\right)}{\frac{r\omega}{L}\tan d} + C_y$$

$\Rightarrow$ Our final equations are,

$$\boxed{\begin{aligned} x &= \frac{v_s \sin\left(\left(\left(\frac{r\omega}{L}\right)\tan d\right)t + \theta_i\right)}{\frac{r\omega}{L}\tan d} + C_x \\ y &= \frac{-v_s \cos\left(\left(\frac{r\omega}{L}\tan d\right)t + \theta_i\right)}{\frac{r\omega}{L}\tan d} + C_y \\ \theta &= \left(\frac{r\omega}{L}\tan d\right)t + \theta_i \end{aligned}}$$