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Mechatronics Engineering
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Assignment

the parametric equations of a curve are as given in equation 1&2

$$x = \cos t + t\sin t \quad \text{---(1)}$$
$$y = \sin t - t\cos t \quad \text{---(2)}$$

$$\frac{dx}{dt} = -\sin t + t\cos t + \sin t = t\cos t$$

$$= t\sin t$$

using Product rule

$u = t$, $v = \sin t$

$$\frac{du}{dt} = 1, \quad \frac{dv}{dt} = \cos t$$

$$u\frac{dv}{dt} + v\frac{du}{dt}$$

$$= t\cos t + \sin t$$

$$\therefore \frac{dy}{dt} = \cos t + t\sin t - \cos t = t\sin t$$

Using Product rule

$u = -t \quad v = \cos t$

$$\frac{du}{dt} = -1 \quad \frac{dv}{dt} = -\sin t$$

$$v\frac{du}{dt} + u\frac{dv}{dt}$$

$$= t\sin t - \cos t$$

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dx}{dt}$$

$$= \frac{t\sin t}{t\cos t}$$

$$= \tan t$$

$$d^2y/dx^2 = \sec^2 t$$

1) $$R = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\frac{d^2y}{dx^2}}$$

$$= \frac{\left[1 + (t \tan t)^2\right]^{3/2}}{t \sec^2 t}$$

2) $h = x - R \sin\theta$

$k = y + R\cos\theta$

$$\tan\theta = \frac{dy}{dx}$$

$$\theta = \tan^{-1}\left[\frac{dy}{dx}\right]$$

From equation (1) $x = \cos t + t \sin t$

From equation (2) $y = \sin t - t\cos t$

From question (1) $R = \frac{\left[1 + (\tan t)^2\right]^{3/2}}{\sec^2 t}$

$$h = (\cos t + t\sin t) - \left[\frac{(1 + (\tan t)^2)^{3/2}}{\sec^2 t}\right] \sin\left[\tan^{-1}(\tan t)\right]$$

$$x = (\sin t - t\cos t) - \left[\frac{(1 + (\tan t)^2)^{3/2}}{\sec^2 t}\right] \cos\left[\tan^{-1}(\tan t)\right]$$