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Course	Eng 281
Dept	mechanical Engineering
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1 $x = \cos t + t\sin t$

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

a. an expression for the radius of curvature (R) in terms of t

Ans

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

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

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

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

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

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

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

$\frac{d^2y}{dx^2}$

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

$du/dt = \cos t$ $dv/dt = -\sin t$

$\frac{V\frac{du}{dx} - U\frac{dv}{dx}}{V^2}$

$\frac{\cos t(\cos t) - (\sin t)(-\sin t)}{(\cos t)^2} \times \frac{1}{t\cos t}$

$\frac{\cos^2 t + \sin^2 t}{\cos^2 t} \times \frac{1}{t\cos t}$

$$\frac{d^2y}{dx^2} = \frac{1}{t\cos^3 t}$$

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

$$R = \frac{\left(1 + \left(\frac{\sin t}{\cos t}\right)^2\right)^{3/2}}{d^2y/dx^2}$$

$$R = \frac{\left(1 + \frac{\sin^2 t}{\cos^2 t}\right)^{3/2}}{\frac{1}{t\cos^3 t}}$$

$$R = \frac{\left(\frac{\cos^2 t + \sin^2 t}{\cos^2 t}\right)^{3/2}}{\frac{1}{t\cos^3 t}}$$

$$R = \frac{\left(1/\cos^2 t\right)^{3/2}}{1/t\cos^3 t}$$

$$R = \frac{1/\cos^3 t}{1/t\cos^3 t}$$

$$R = \frac{1}{\cos^3 t} \times t\cos^3 t$$

$$R = t$$

) expressessions for the coordinates (h, k) of the centre of curvature in terms of t

Ans

$h = x_1 - R\sin\theta$

$k = y_1 + R\cos\theta$

$R = t, \quad \theta = \tan^{-1}(dy/dx)$

$$\frac{dy}{dx} = \frac{\sin t}{\cos t} = \tan t$$

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$t\theta$

$\theta = t$

$h = x_1 - t \sin t$

$k = y_1 + t \cos t$

but $x = \cos t + t \sin t$

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

$h = \cos t + t \sin t - t \sin t$

$h = \cos t$

$k = \sin t - t \cos t + t \cos t$

$k = \sin t$

$(h, k) = (\cos t, \sin t)$