Bitrus Romanus Kura.

1. $x = \cos t + t\sin t$; $y = \sin t - t\cos t$

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

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

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

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

$$\frac{dy}{dt} = t\sin t$$

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

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

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

$$\frac{dx}{dt} = t\cos t$$

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

$$\frac{d^2y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d}{dt}\left(\frac{dy}{dx}\right)\frac{dt}{dx}$$

Using quoetiont rule

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

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

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

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

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

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

$$= \left[\frac{\cos^2 t + \sin^2 t}{\cos^2 t}\right]^{3/2} \times t \cos^3 t$$

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

$$= \frac{1}{(\cos^2 t)^{3/2}} \times t \cos^3 t$$

$$= \frac{t \cos^3 t}{\cos^3 t}$$

$$R = t.$$

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ii) (h, k)

Recall; $h = x_1 - R\sin\theta$ — ①

$K = y_1 + R\cos\theta$ — ②

$R = t \qquad \theta = t$

$x_1 = \cos t + t\sin t$

$y_1 = \sin t - t\cos t$

Substituting R, x_1, y_1, into h and k
[i.e eqn ① and ②]

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

$h = \cos t$

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

$k = \sin t$

Therefore the Co-ordinate for the Centre Can be given as $(\cos t, \sin t)$.