MAT 116E Advanced Scientific and Engineering Computing

Lab-3 / CRN : 12852

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1 Question 1

Write a MATLAB Script File to plot Cayley's Curve on the xy plane over the parametric interval $-2\pi \leq t \leq 2\pi$, where $\alpha = 3$:

$$x = 4\alpha\left[\frac{1-3t^2}{(1+t^2)^3}\right] \qquad y = 4\alpha\left[\frac{t(3-t^2)}{(1+t^2)^3}\right]$$

Also, plot a Doppler Spiral on the same plot for $b = 2.2, k = 0.5$, and $-2\pi \leq t \leq 2\pi$:

$$x = b\Big[t\cos(t) + kt\Big] \qquad y = bt\sin(t)$$

Make sure to use enough points to create smooth curves. Provide a plot title, labels for the axes and a legend for the curves.

2 Question 2

Write a MATLAB program to sketch the surface $z = x^2 + xy + y^3 - 2$ and its tangent plane and normal line at $P_0 = (1,1,1)$ in the same figure.

Tangent plane equation at (1,1,1):

$$P\vec{P}_0 \cdot \vec{\nabla} f\Big|_{P_0} = 0 \text{ where } f = z - x^2 - xy - y^3 + 2$$

$$P\vec{P}_0 \cdot \vec{\nabla} f\Big|_{P_0} = f_x(1,1,1)(x-1) + f_y(1,1,1)(y-1) + f_z(1,1,1)(z-1) = -3(x-1) - 4(y-1) + (z-1) = 0$$

$$\boxed{z - 3x - 4y + 6 = 0}$$

Normal Line equation at (1,1,1):

$$P\vec{P}_0 = \vec{\nabla} f\Big|_{P_0} \cdot t \implies x - x_0 = f_x(1,1,1)t \qquad y - y_0 = f_y(1,1,1)t \qquad z - z_0 = f_z(1,1,1)t$$

$$\boxed{x = 1 - 3t \quad ; \quad y = 1 - 4t \quad ; \quad z = 1 + t}$$