1.

$r : \Re \to \Re^3$

$r(t) = (r_1(t), r_2(t), r_3(t)) = (x, y, z)$

$r_1 : \Re \to \Re$

$r_2 : \Re \to \Re$

$r_3 : \Re \to \Re$

$$\begin{cases} x^2 + y^2 - z = 0 \Rightarrow z = x^2 + y^2 \\ x^2 - 4x + y^2 + z = 0 \Rightarrow z = 4x - x^2 - y^2 \end{cases} \Rightarrow$$

$$\begin{cases} z = x^2 + y^2 : \star \\ x^2 - 4x + y^2 + z = 0 \overset{\star}{\Rightarrow} x^2 + y^2 = 4x - x^2 - y^2 : \star' \end{cases}$$

$\star' : x^2 + y^2 = 4x - x^2 - y^2 \Rightarrow$

$2x^2 - 4x + 2y^2 = 0 \Rightarrow$

$x^2 - 2x + y^2 = 0 \Rightarrow$

$(x-1)^2 - 1 + y^2 = 0 \Rightarrow$

$(x-1)^2 + y^2 = 1$ Que en $\Re^2$ es un circulo de radio 1 con centro en $(1, 0) \Rightarrow$

$$\begin{cases} x - 1 = \cos(t) \Rightarrow x = \cos(t) + 1 = r_1(t) \\ y = \sin(t) = r_2(t) \\ z = x^2 + y^2 \Rightarrow z = (\cos(t) + 1)^2 + \sin(t)^2 = r_3(t) \end{cases} \Rightarrow$$

$r(t) = (\cos(t) + 1, \sin(t), (\cos(t) + 1)^2 + \sin(t)^2) = C$

2. QvQ $P = (1 - \frac{\sqrt(2)}{2}, \frac{\sqrt{2}}{2}, 2 - \sqrt{2}) \in C \Leftrightarrow$

$\exists k \in \Re : r(k) = P \Leftrightarrow$

$$\begin{cases} \cos(k) + 1 = 1 - \frac{\sqrt(2)}{2} \\ \sin(k) = \frac{\sqrt{2}}{2} \\ (\cos(k) + 1)^2 + \sin(k)^2 = 2 - \sqrt{2} \end{cases} \Rightarrow$$

$\sin(k) = \frac{\sqrt{2}}{2} \Leftrightarrow k_1 = \frac{\pi}{4} \vee k_2 = \frac{3\pi}{4}$

$\cos(k_1) + 1 = \frac{\sqrt{2}}{2} + 1 \Rightarrow \cancel{k_1}$

$\cos(k_2) + 1 = -\frac{\sqrt{2}}{2} + 1 \checkmark$

$(\cos(k_2) + 1)^2 + \sin(k_2)^2 = (-\frac{\sqrt{2}}{2} + 1)^2 + 2 = \frac{1}{2} - \sqrt{2} + 1 + \frac{1}{2} = 2 - \sqrt{2} \checkmark$

$\Rightarrow r(k) = P \Rightarrow P \in C$

$(x, y, z) = \lambda \cdot r'(k) + P$

$$\begin{cases} r_1'(t) = -\sin(t) \\ r_2'(t) = \cos(t) \\ r_3'(t) = -2\sin(k) \end{cases} \Rightarrow$$

$$\begin{cases} r_1'(k) = -\frac{\sqrt{2}}{2} \\ r_2'(k) = -\frac{\sqrt{2}}{2} \\ r_3'(k) = -\sqrt{2} \end{cases} \Rightarrow$$

$(x, y, z) = \lambda \cdot (-\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}, -\sqrt{2}) + (1 - \frac{\sqrt(2)}{2}, \frac{\sqrt{2}}{2}, 2 - \sqrt{2})$