Helix Antenna - Axial mode

$F_r = 1.5\,GHz$ in space sattelite (GPS)

So, height of the antenna $h > \lambda$

$$\lambda = \frac{c}{f} = \frac{3\times10^8}{1.5\times10^9} = 0.2\,m$$

So, $h = 1.5 \times \lambda = 0.3\,m$

$$\boxed{h = 0.3}$$

Circumference of antenna $\approx \lambda$

$$C \approx \lambda.$$

$$C \approx 0.2\,m$$

$$2\pi a = 0.2$$

$$a = \frac{0.2}{2\pi}$$

$$\boxed{a = 0.0318\,m}$$

height (m)	radius (m)	Turns	groundplane (m)	r	Z(expected)	Z(got)
0.35	0.035	10	0.15	0.54	143.0	142.05 122.59-j71.76
0.3	0.035	10	0.15	0.42	143.0	121.06 119.3-j20.13
0.35	0.035	20	0.15	0.54	143.0	94.79 61.8-j71.87
0.35	0.035	7	0.15	0.51	143.0	147.278 141.19-j41.9

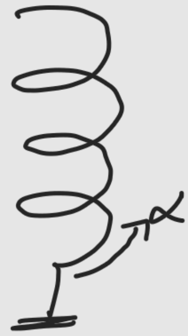
Usually 's' distance b/w the coils is $(0.25 \times \lambda)$.

So, $S = 0.25 \times 0.2$

$$\boxed{S = 0.05\,m}$$

Number of turns, $N = \frac{H}{S} = \frac{0.35}{0.05} = 7$

Also, another understanding is Pitch angle is taken from 12° to 14° & selected 13°. So, for this to happen, $\alpha = \tan^{-1}\left(\frac{S}{C}\right)$



$$13 = \tan^{-1}\left(\frac{S}{C}\right)$$

$$\tan(13^\circ) = \tan\left[\tan^{-1}\left(\frac{S}{C}\right)\right]$$

$$S = 0.23 \times 2 \times \pi \times 0.035$$

$$\boxed{S = 0.05} \text{ m}$$

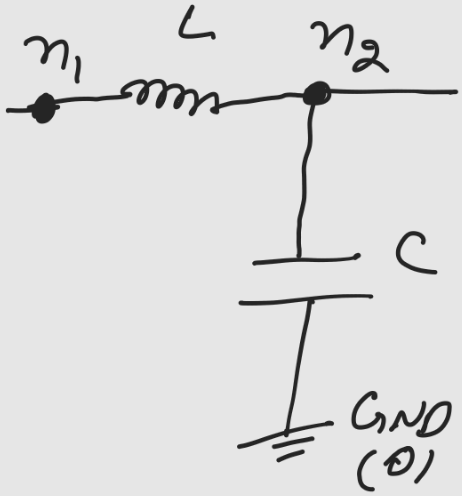
Matching N/w

$Z_L = 141.19 - j41.9$; $Z_0 = 50$; $f = 1.5\,GHz$

$$y_L = \frac{Z_0}{Z_L} = \frac{50}{141.19 - j41.9} = 0.325 + 0.096j$$

$$\boxed{g = 0.325} \quad \boxed{b = 0.096}$$

$$L = \frac{Z_0\sqrt{g^{-1} - 1}}{2\pi f} = 7.64\,nH$$



$$C = \frac{-b + \sqrt{g - g^2}}{2\pi f Z_0} = 0.79\,pF$$

Note:- Due to restriction of student version I simulated only discrete points of frequencies.

f (GHz)	0.1	0.5	1	1.5	2	2.5	3

Fr

The reflection coefficient plot would be curve if I could have simulated continuous frequency points.

According to theory, the input impedance of Helix antenna should approx 140 Ω, later matched to 50Ω.

Formula

$$G = 10.8 + 10\log_{10}\left[\left(\frac{C}{\lambda}\right)^2 \cdot N \cdot \left(\frac{S}{\lambda}\right)\right]$$

From, Kraus - Antenna's for all applications.

$$Z = \frac{150}{\sqrt{C/\lambda}}\ \Omega$$

$$D = \lambda/\pi$$

$$S = C/4$$

$$L = N \cdot \sqrt{\lambda^2 + S^2}$$