10.19 Design a five-turn helical antenna which at 400 MHz operates in the normal mode. The spacing between turns is $\lambda_0/40$. It is desired that the antenna possesses circular polarization. Determine the

(a) circumference of the helix (in λ_0 and in meters)

(b) length of a single turn (in λ_0 and in meters)

(c) overall length of the entire helix (in λ_0 and in meters)

(d) pitch angle (in degrees).

- Assume spacing is $\lambda_0/40$.

$$\lambda_0 = \frac{2.998\times10^8}{400\times10^6} = 0.7495\,m = \lambda$$

a) Circular polarization → Wheeler helix

Per (10-28a), $C = \sqrt{25\lambda} = \sqrt{2(\lambda/40)\lambda}$

$$\underline{\underline{C = 0.2236\,\lambda = 0.1676\,m}}$$

b) From Fig 10.13, $L_0 = \sqrt{C^2+S^2} = \sqrt{\frac{2\lambda^2}{40}+\frac{\lambda^2}{40^2}}$

$$\underline{\underline{L_0 = 0.225\,\lambda = 0.16864\,m}}$$

c) Note $L_n = NL_0 = 5(0.225\,\lambda) = 5(0.16864)$

$$\underline{\underline{L_n = 1.125\,\lambda = 0.84319\,m}}$$

d) Per (10-24), $\alpha = \tan^{-1}(S/C) = \tan^{-1}\left(\frac{\lambda/40}{0.2236\lambda}\right)$

$$\underline{\underline{\alpha = 6.3794^\circ}}$$