## EE 483/583 Antennas for Wireless Communications Quiz #9 (Spring 2025)

Name <u>KEY</u>

Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

A 4-turn helical antenna is to be used at 600 MHz in free space. Given that the antenna is 57.6 mm tall and has a diameter of 6.35 mm, will the antenna operate in normal or axial mode? Why? Find the turn spacing (mm), pitch angle (deg), overall wire length (mm), circumference in terms of wavelengths  $C/\lambda$ , and axial ratio. Let  $c = 2.9979 \times 10^8$  m/s.

Wavelength  $\lambda = c/f = 2.9979 \times 10^8 / 600 \times 10^6 = 0.49965 \text{ m} = 499.645 \text{ mm}.$ 

 $C = \pi D = \pi (6.35 \text{ mm}) = 19.9491 \text{ mm}.$ 

From p. 549 of text,  $L = NS \implies$  turn spacing is  $S = L/N = 57.6/4 \implies S = 14.4 \text{ mm}.$ 

Per (10.24), pitch angle  $\alpha = \tan^{-1}(S/C) = \tan^{-1}(14.4/19.94911) \implies \alpha = 35.82313^{\circ}$ .

From p. 549 of text, wire length  $L_n = NL_0 = N\sqrt{S^2 + C^2} = 4\sqrt{14.4^2 + 19.94911^2}$  $\Rightarrow L_n = 98.414 \text{ mm}.$ 

Per (10.27), 
$$AR = \frac{2\lambda S}{(\pi D)^2} = \frac{2\lambda S}{C^2} = \frac{2(499.645)14.4}{19.94911^2} \implies AR = 36.1582$$

helix is essentially linearly polarized in vertical direction.

Note that  $C/\lambda = 0.039 \ll 1$  &  $L_n = 98.4$  mm  $\ll \lambda = 500$  mm  $\Rightarrow$  **normal mode** 

**normal** or axial mode? (circle correct) Why?  $C/\lambda = 0.039 << 1 \& L_n << \lambda$ turn spacing =  $\underline{S} = 14.4 \text{ mm}$  pitch angle (deg) =  $\underline{\alpha} = 35.823^{\circ}$ overall wire length =  $\underline{L_n} = 98.414 \text{ mm}$   $C/\lambda = \underline{0.039}$  axial ratio =  $\underline{36.16}$