

## EE 483/583 Antennas for Wireless Communications Quiz #2 (Spring 2022)

Name Key

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

For a uniform plane wave in free space, the electric field given by

$$\vec{E}(x,t) = 2 \cos(\omega t - 24x + \pi) \hat{a}_y - 3 \sin(\omega t - 24x + \pi/2) \hat{a}_z \quad (\text{V/m}).$$

What direction is the wave propagating? Sketch the polarization ellipse/trace on provided axes so wave propagates into the page and positive axes are to the right/top. Include all appropriate labels such as scale, plane of space, etcetera. Find the polarization of the electric field (e.g., LH circular, linear, ...). Estimate the axial ratio (AR), and tilt angle  $\tau$  (in degrees CW with respect to the positive vertical axis) of the wave.

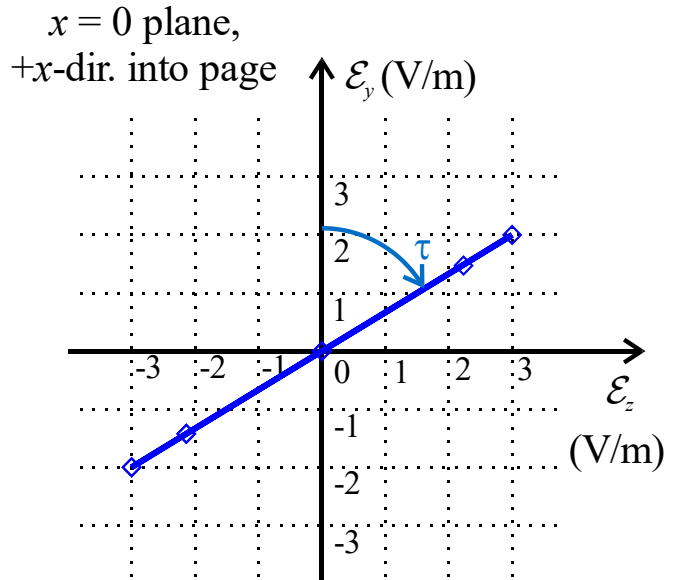
Note that wave propagates in the  $+x$ -dir. from  $-24x$  terms. For plot, choose  $x = 0$  plane and  $+E_y$  for top vertical axis &  $+E_z$  for RH horizontal axis so wave propagates into page.

$$n := 0..8 \quad \omega t_n := n \frac{\pi}{4} \quad E_{y_n} := 2 \cos(\omega t_n + \pi) \quad E_{z_n} := -3 \sin\left(\omega t_n + \frac{\pi}{2}\right)$$

$\omega t_n =$	$E_{y_n} =$	$E_{z_n} =$
0	-2	-3
0.785	-1.414	-2.121
1.571	0	0
2.356	1.414	2.121
3.142	2	3
3.927	1.414	2.121
4.712	0	0
5.498	-1.414	-2.121
6.283	-2	-3

$$\tau := \text{atan}\left(\frac{3}{2}\right) \cdot \frac{180}{\pi}$$

$$\tau = 56.3099 \quad \text{degrees}$$



Direction of propagation is +x-direction

Polarization is Linear      AR =  $\infty$        $\tau =$  56.31°