

## EE 483/583 Antennas for Wireless Communications Quiz #2 (Spring 2026)

Name KEY A

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

An antenna has a far-zone electric field  $\vec{\mathcal{E}} = \hat{a}_y 2 \cos(\omega t + 3.34x) - \hat{a}_z 2 \cos(\omega t + 3.34x - \pi/3)$  (V/m) at some point in free space. In what direction is the wave propagating? On the provided axes, sketch to scale the polarization ellipse so that the direction of wave propagation is **into** the page w/ positive axes up/right. Include labels such as sense of ellipse, plane of space, etcetera. Determine the polarization of the electric field (e.g., LH circular, linear, ...). Estimate axial ratio and tilt angle wrt  $\mathcal{E}_z$  in CCW direction

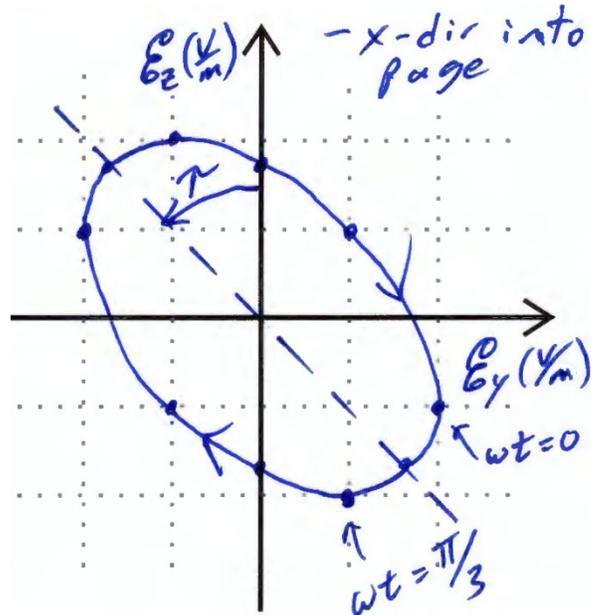
The '+3.34x' term indicates propagation in the -x-direction.

Since  $|E_y| = |E_z| = 2$  V/m but  $\Delta\phi \neq n\pi/2 \Rightarrow$  elliptical polarization.

From polarization ellipse, the sense is RH.

Draw polarization ellipse for  $x = 0$  plane  $\Rightarrow \vec{\mathcal{E}} = \hat{a}_y 2 \cos(\omega t) - \hat{a}_z 2 \cos(\omega t - \pi/3)$  (V/m).

$\omega t$ (rad)	$\mathcal{E}_y = 2 \cos(\omega t)$ (V/m)	$\mathcal{E}_z = -2 \cos(\omega t - \pi/3)$ (V/m)
0	2	-1
$\pi/6$	<b>1.732</b>	<b>-1.732</b>
$\pi/3$	1	-2
$\pi/2$	0	-1.732
$2\pi/3$	-1	-1
$\pi$	-2	1
$4\pi/3$	-1	2
$3\pi/2$	0	1.732
$5\pi/3$	1	1



$$\text{axial ratio} = \text{AR} = \frac{\max |\mathcal{E}|}{\min |\mathcal{E}|} = \frac{\sqrt{1.732^2 + (-1.732)^2}}{\sqrt{(-1)^2 + (-1)^2}} = \underline{1.732}$$

$$\text{tilt angle} = \tau = \tan^{-1} \left( \frac{1.732}{1.732} \right) = \underline{45^\circ}$$

Direction of propagation is -x-direction      Polarization is RH elliptical polarization

axial ratio is 1.732      tilt angle is 45°

## EE 483/583 Antennas for Wireless Communications Quiz #2 (Spring 2026)

Name KEY B

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

An antenna has a far-zone electric field  $\vec{\mathcal{E}} = -\hat{a}_y 2 \cos(\omega t + 8.85x) + \hat{a}_z 2 \cos(\omega t + 8.85x + \pi/3)$  (V/m) at some point in free space. In what direction is the wave propagating? On the provided axes, sketch to scale the polarization ellipse so that the direction of wave propagation is **into** the page w/ positive axes up/right. Include labels such as sense of ellipse, plane of space, etcetera. Determine the polarization of the electric field (e.g., LH circular, linear, ...). Estimate axial ratio and tilt angle wrt  $\mathcal{E}_z$  in CCW direction

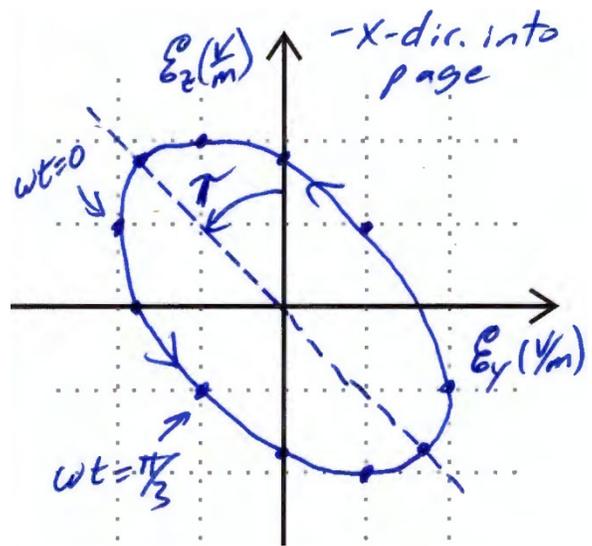
The '+8.85x' term indicates propagation in the -x-direction.

Since  $|E_y| = |E_z| = 2$  V/m but  $\Delta\phi \neq n\pi/2 \Rightarrow$  elliptical polarization.

From polarization ellipse, the sense is LH.

Draw polarization ellipse for  $x=0$  plane  $\Rightarrow \vec{\mathcal{E}} = -\hat{a}_y 2 \cos(\omega t) + \hat{a}_z 2 \cos(\omega t + \pi/3)$  (V/m).

$\omega t$ (rad)	$\mathcal{E}_y = -2 \cos(\omega t)$ (V/m)	$\mathcal{E}_z = 2 \cos(\omega t + \pi/3)$ (V/m)
0	-2	1
$\pi/6$	-1.732	0
$\pi/3$	-1	-1
$\pi/2$	0	-1.732
$2\pi/3$	1	-2
$5\pi/6$	1.732	-1.732
$\pi$	2	-1
$4\pi/3$	1	1
$3\pi/2$	0	1.732
$5\pi/3$	-1	2



$$\text{axial ratio} = \text{AR} = \frac{\max |\mathcal{E}|}{\min |\mathcal{E}|} = \frac{\sqrt{1.732^2 + (-1.732)^2}}{\sqrt{(-1)^2 + (-1)^2}} = \underline{1.732}$$

$$\text{tilt angle} = \tau = \tan^{-1} \left( \frac{1.732}{1.732} \right) = \underline{45^\circ}$$

Direction of propagation is -x-direction      Polarization is LH elliptical polarization

axial ratio is 1.732      tilt angle is 45°