EE 483/583 Antennas for Wireless Communications
Quiz #2 (Spring 2024)

Name Key

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

An antenna has a far-zone electric field $\bar{\mathcal{E}}(x,t) = \hat{a}_y\, 2\cos(\omega t + 96x) - \hat{a}_z\, 3\sin(\omega t + 96x + \pi/2)$ (V/m) at some point in free space. In what direction is the wave propagating? Sketch the polarization ellipse on the provided axes so that the direction of wave propagation is into the page w/ positive axes to right/top. Include all appropriate labels such as scale, plane of space, etcetera. Determine the polarization of the electric field (e.g., LH circular, RH elliptical, linear, …). Find the axial ratio (AR) and tilt angle τ (deg) with respect to the vertical axis of the polarization ellipse.

From "+96x" term, wave propagates in -x-dir.

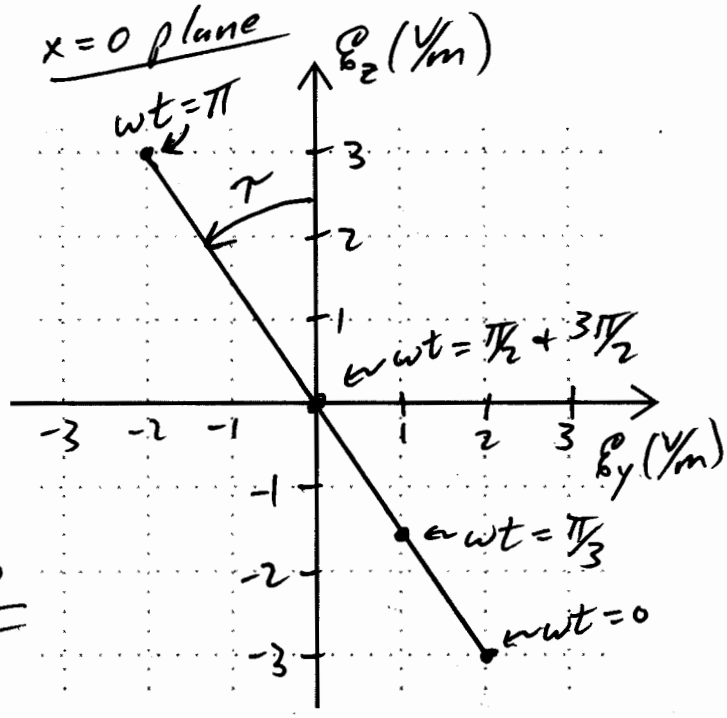
For polarization ellipse, choose $x=0$ plane where $\bar{\mathcal{E}}^{\phi}(0,t) = \hat{a}_y\, 2\cos(\omega t) - \hat{a}_z\, 3\sin(\omega t + \pi/2)$ (V/m)

ωt	$\bar{\mathcal{E}}^{\phi}$ (V/m)
0	$2\hat{a}_y - 3\hat{a}_z$
$\pi/2$	0
π	$-2\hat{a}_y + 3\hat{a}_z$
$3\pi/2$	0
$\pi/3$	$\hat{a}_y - 1.5\hat{a}_z$

$\hat{a}_z \times \hat{a}_y = -\hat{a}_x$

-x-dir. into the page

$x=0$ plane



$\tau = \tan^{-1}\left(\frac{2}{3}\right) = 33.69°$

$AR = \frac{\text{Major}}{\text{Minor}} = \frac{2\sqrt{2^2+3^2}}{0} \to \infty$

Direction of propagation is -X-dir.

Polarization is linear AR = ∞ τ = 33.69°