EE 483/583 Antennas for Wireless Communications
Quiz #2 (Spring 2025)

Name KEY A

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

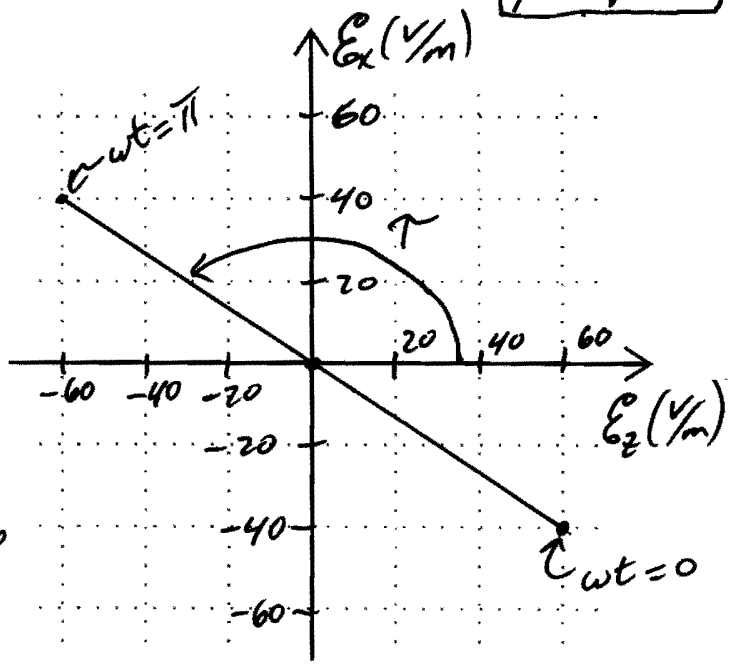
A uniform plane wave is propagating through free space. It has an electric field given by $\bar{\mathcal{E}}(y,t) = -\hat{a}_x\, 40\cos(\omega t + 44y) + \hat{a}_z\, 60\sin(\omega t + 44y - 3\pi/2)$ (V/m). What direction is the wave propagating? Sketch the polarization ellipse on the provided axes so that the direction of wave propagation is into the page. 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, …), axial ratio (AR), and tilt angle τ (in degrees CCW with respect to the positive horizontal axis) of the polarization ellipse.

* From '+44y' term, the wave propagates in the −y-direction
* Plot polarization ellipse on the y=0 plane.
* To get wave propagation into page, choose $\mathcal{E}_x$ to be vertical axis since $\hat{a}_x \times \hat{a}_z = -\hat{a}_y$.

ωt	$\mathcal{E}_x = -40\cos(\omega t)$	$\mathcal{E}_z = 60\sin(\omega t - 3\pi/2)$
0	−40 V/m	60 V/m
π/4	−28.3	42.4
π/2	0	0
3π/4	28.3	−42.4
π	40	−60

propag. into page

y=0 plane



$\tau = 90° + \tan^{-1}\left(\frac{60}{40}\right) = 146.3°$

$= 180° - \tan^{-1}\left(\frac{40}{60}\right) = 2.554$ rad

$AR = \frac{\text{major}}{\text{minor}} = \frac{2\sqrt{60^2+40^2}}{0} \to \infty$

Direction of propagation is −y-direction

Polarization is linear AR = ∞ τ = 146.3°

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Name KEY B

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

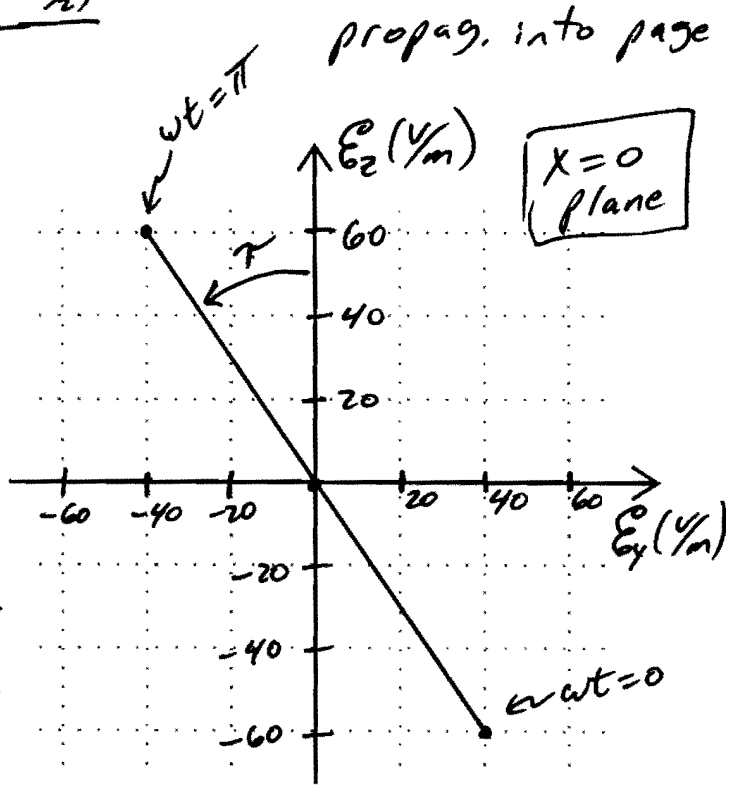
A uniform plane wave is propagating through free space. It has an electric field given by $\bar{\mathcal{E}}(x,t) = \hat{a}_y\, 40\cos(\omega t + 60x) - \hat{a}_z\, 60\sin(\omega t + 60x - 3\pi/2)$ (V/m). What direction is the wave propagating? Sketch the polarization ellipse on the provided axes so that the direction of wave propagation is into the page. 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, …), axial ratio (AR), and tilt angle τ (in degrees CCW with respect to the positive vertical axis) of the polarization ellipse.

* From '+60x' term, the wave propagates in the -x-direction
* Plot polarization ellipse on the x=0 plane.
* Choose $\mathcal{E}_z$ to be vertical axis since $\hat{a}_z \times \hat{a}_y = -\hat{a}_x$ will give wave propagation into page.

ωt	$\mathcal{E}_y = 40\cos(\omega t)$	$\mathcal{E}_z = -60\sin(\omega t - 3\pi/2)$
0	40 V/m	-60 V/m
$\pi/4$	28.3	-42.4
$\pi/2$	0	0
$3\pi/4$	-28.3	42.4
π	-40	60

$$\tau = \tan^{-1}\frac{40}{60} = 33.69^\circ = 0.588 \text{ rad}$$

$$AR = \frac{\text{major}}{\text{minor}} = \frac{2\sqrt{60^2+40^2}}{0} \to \infty$$



Direction of propagation is -x-direction

Polarization is linear AR = ∞ τ = 33.69°