10.1 An EM wave propagating in a certain medium is described by

$$\mathbf{E} = 25 \sin(2\pi \times 10^6 t - 6x)\mathbf{a}_z \text{ V/m}$$

(a) Determine the direction of wave propagation.
(b) Compute the period T, the wavelength λ, and the velocity u.
(c) Sketch the wave at $t = 0, T/8, T/4, T/2$.

- For part c), plot magnitude of electric field for $0 < x < 2\lambda$ using a computer package on one plot with either legend or traces labeled.

a) From "$-6x$" term in cos( ) argument

wave propag. direction $\underline{\underline{\hat{a}_k = +\hat{a}_x}}$

b) From cos( ) term, $\omega = 2\pi \times 10^6$ rad/s

Per (10.7c), $T = \dfrac{2\pi}{\omega} = \dfrac{2\pi}{2\pi \times 10^6} = \underline{\underline{1\,\mu s}}$

Per (10.8), $\beta = \dfrac{2\pi}{\lambda}$ where from "$-6x$" term in cos( )

we know $\beta = 6$ rad/m $\Rightarrow \lambda = \dfrac{2\pi}{\beta} = \dfrac{2\pi}{6} = \underline{\underline{1.0472\,m}}$

Per (10.7b), $\beta = \omega/u \Rightarrow u = \dfrac{\omega}{\beta} = \dfrac{2\pi \times 10^6}{6} = \underline{\underline{1.0472 \times 10^6\ m/s}}$

c) Used MathCad to plot $|\bar{E}|$ for $0 < x < 2(1.0472\,m)$

for $t = 0, \dfrac{1\,\mu s}{8}, \dfrac{1\,\mu s}{4}, + \dfrac{1\,\mu s}{2}$ on next

page.

10.1 c)

$T := 1 \cdot 10^{-6}$ s $\beta := 6$ rad/m $\omega := 2 \cdot \pi \cdot 10^{6}$ rad/s

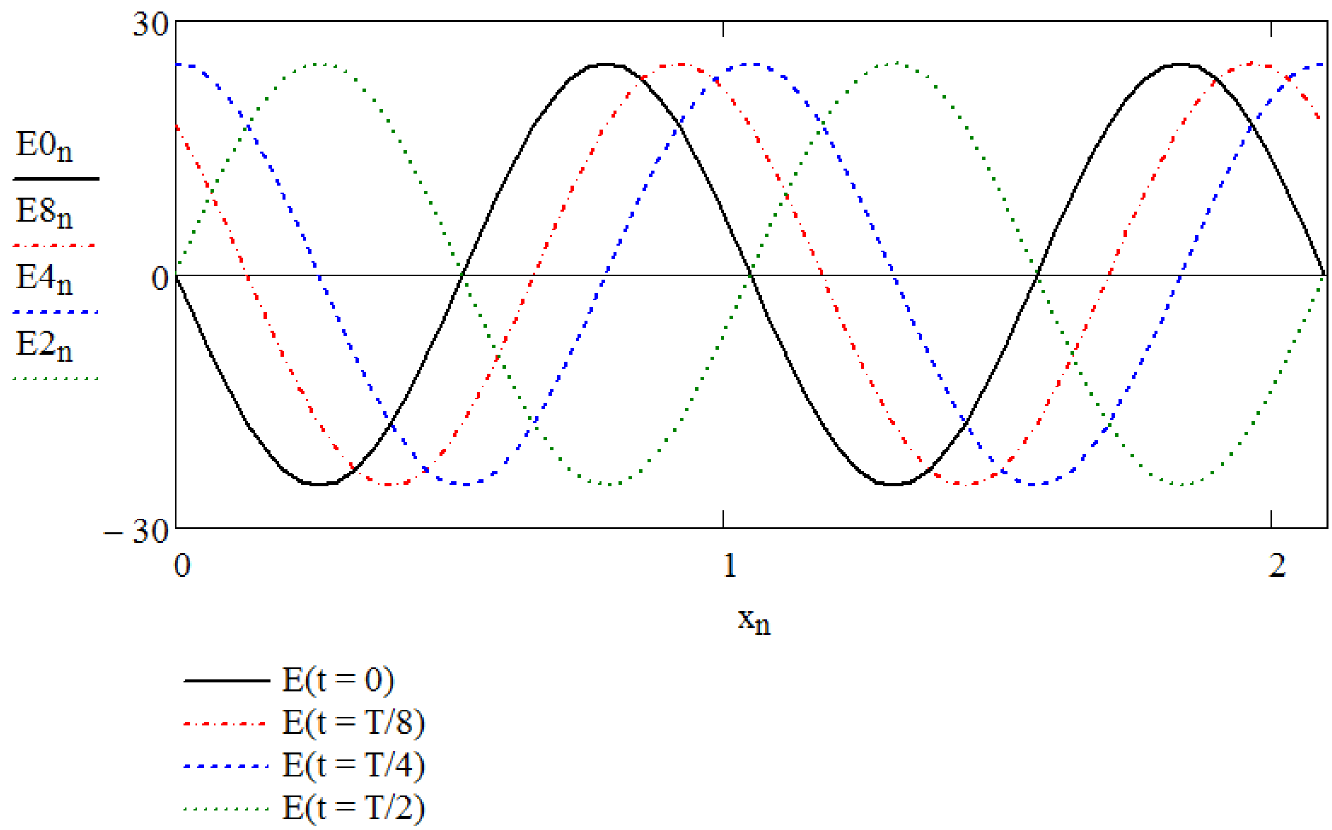
$\lambda := \dfrac{2 \cdot \pi}{\beta}$ $n := 0 .. 64$ $x_n := \dfrac{2\lambda}{64} \cdot n$

For t = 0: $E0_n := 25 \cdot \sin(\omega \cdot 0 - \beta \cdot x_n)$

For t = T/8: $E8_n := 25 \cdot \sin\left(\omega \cdot \dfrac{T}{8} - \beta \cdot x_n\right)$

For t = T/4: $E4_n := 25 \cdot \sin\left(\omega \cdot \dfrac{T}{4} - \beta \cdot x_n\right)$

For t = T/2: $E2_n := 25 \cdot \sin\left(\omega \cdot \dfrac{T}{2} - \beta \cdot x_n\right)$



Note that wave is indeed propagating in +*x*-direction as time advances.