At 100 MHz, the datasheet for a distortionless transmission line gives R = 16 Ω/km, C = 56 nF/km, and L = 0.46 mH/km. Calculate the: a) conductance G per-unit-length, b) attenuation constant α (Np/m & dB/m), phase constant β, & propagation constant γ, c) characteristic impedance Z_0, and d) phase velocity u & wavelength λ.

R = 16 Ω/km = 0.016 Ω/m, C = 56 nF/km = 56 pF/m, and L = 0.46 mH/km = 0.46 μH/m.

a) Per (11.22) $R/L = G/C \Rightarrow G = C\,R/L = 56\times10^{-12}(0.016)/0.46\times10^{-6}$

$\Rightarrow$ **$G = 1.9478\times10^{-6}$ S/m = 1.9478 μS/m**

b) Per (11.23a) $\alpha = \sqrt{RG} = \sqrt{[0.016]1.947826\bullet10^{-6}}$

$\Rightarrow$ **$\alpha = 0.00017654$ Np/m**

α (dB/m) = α (Np/m) (8.686 dB/Np) $\Rightarrow$ **$\alpha = 0.0015334$ dB/m**

Per (11.23a) $\beta = \omega\sqrt{LC} = 2\pi100\bullet10^{6}\sqrt{[0.46\bullet10^{-6}]56\bullet10^{-12}}$

$\Rightarrow$ **$\beta = 3.188987$ rad/m**

Per (11.11), the propagation constant is $\gamma = \alpha + j\beta$

$\Rightarrow$ **$\gamma = 0.00017654 + j\,3.188987$ 1/m**

OR

$$\gamma = \sqrt{(R+j\omega L)(G+j\omega C)}$$
$$= \sqrt{[0.016 + j(2\pi100\bullet10^{6})0.46\bullet10^{-6}][1.9478\bullet10^{-6} + j(2\pi100\bullet10^{6})56\bullet10^{-12}]}$$

$\Rightarrow$ **$\gamma = 0.00017654 + j\,3.188987$ 1/m**

c) Per (11.23b), $Z_0 = \sqrt{\dfrac{L}{C}} = \sqrt{\dfrac{0.46\bullet10^{-6}}{56\bullet10^{-12}}}$ $\Rightarrow$ **$Z_0 = 90.633\ \Omega$**

d) Per (11.23c), $u = \dfrac{1}{\sqrt{LC}} = \dfrac{1}{\sqrt{0.46\bullet10^{-6}(56\bullet10^{-12})}}$ $\Rightarrow$ **$u = 1.970276\times10^{8}$ m/s**

$\lambda = u/f = 1.970276\times10^{8} / 100\times10^{6}$ $\Rightarrow$ **$u = 1.970276$ m**