For the planar transmission line, find the propagation constant γ, attenuation constant α (Np/m & dB/m), phase constant β, wavelength λ, phase velocity u, and characteristic impedance Z_0.

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From prior problem, the distributed parameters are:

R = 12.7812 Ω/m, L = 510.823 nH/m, G = 2.46002 mS/m, & C = 77.3244 pF/m

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Per (11.11),

$$\gamma = \sqrt{(R + j\omega L)(G + j\omega C)} = \alpha + j\beta$$

$$= \sqrt{[12.7812 + j(2\pi 2.4\bullet 10^9)510.823\bullet 10^{-9}][0.00246002 + j(2\pi 2.4\bullet 10^9)77.3244\bullet 10^{-12}]}$$

$$\Rightarrow \quad \underline{\gamma = 0.1786 + j\,94.773\ 1/\text{m}}$$

$$\alpha = \text{Re}(\gamma) \quad \Rightarrow \quad \underline{\alpha = 0.1786\ \text{Np/m}}$$

$$\alpha = 0.1786\ \text{Np/m}\ (8.6859\ \text{dB/Np}) \quad \Rightarrow \quad \underline{\alpha = 1.5513\ \text{dB/m}}$$

$$\beta = \text{Im}(\gamma) \quad \Rightarrow \quad \underline{\beta = 94.773\ \text{rad/m}}$$

Per (11.13), $\lambda = 2\pi/\beta = 2\pi/94.773 \quad \Rightarrow \quad \underline{\lambda = 0.066297\ \text{m}}$

Per (11.14), $u = \omega/\beta = 2\pi(2.4*10^9)/94.773 \quad \Rightarrow \quad \underline{u = 1.59113*10^8\ \text{m/s}}$

Per (11.19), $Z_0 = \sqrt{\dfrac{R + j\omega L}{G + j\omega C}} = \sqrt{\dfrac{12.7812 + j(2\pi 2.4\bullet 10^9)510.823\bullet 10^{-9}}{0.00246002 + j(2\pi 2.4\bullet 10^9)77.3244\bullet 10^{-12}}}$

$$\Rightarrow \quad \underline{Z_0 = 81.2787 + j\ 0.0183\ \Omega}$$