For the parallel plate transmission line in 1), calculate: a) propagation constant, b) attenuation constant (both Np/m and dB/m), c) phase constant, d) characteristic impedance (both polar & rectangular forms), e) wavelength, and f) phase velocity.

From 1), $f = 3\,GHz$, $R = 1.73397\ \Omega/m$

$L = 785.4\ nH/m$

$C = 14.592\ pF/m$

$G = 27.505\ \mu S/m$

a) Per (2.5), $\gamma = \sqrt{(R + j\omega L)(G + j\omega C)}$

$$= \sqrt{(1.734 + j2\pi(3\times10^{9})(7.854\times10^{-7}))(2.75\times10^{-5} + j2\pi(3\times10^{9})(1.46\times10^{-11}))}$$

$$\gamma = 0.00693 + j63.8115\ m^{-1}$$

b) Per (2.5), $\alpha = Re(\gamma) = 0.00693\ Np/m = 6.92755\times10^{-3}\ Np/m$

OR

$$\alpha\left(\frac{20\log e\ dB}{1\,Np}\right) = 0.06017\ dB/m$$

c) Per (2.5), $\beta = Im(\gamma) = 63.8115\ rad/m$

d) Per (2.7), $Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}} = 232.00213 - j0.0019866\ \Omega$

$$= 232.002\angle{-0.00049^\circ}\ \Omega$$

e) Per (2.10), $\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{63.8115} \Rightarrow \lambda = 0.098465\,m = 9.85\,cm$

f) Per (2.11), $v_p = \frac{\omega}{\beta} = \frac{2\pi(3\times10^{9})}{63.8115} = 2.95394\times10^{8}\ m/s$