

NANENG 430, Spring 2020

Assignment #1

1. A plane wave propagating in a lossless dielectric medium has an electric field given as $E_x = E_0 \cos(\omega t - \beta z)$ with a frequency of 5 GHz and a wavelength in the material of 3 cm. Determine the propagation constant, the phase velocity, the relative permittivity of the medium, and the wave impedance.
2. For a plane wave of frequency 10 GHz propagating in polystyrene ($\epsilon_r = 2.5, \tan \delta = 0.001$), calculate the attenuation constant, phase velocity, and intrinsic impedance. What are the most important differences over air-dielectric?
3. A medium has a conductivity $\sigma = 4.5 \times 10^{-3} \text{ S/m}$, relative permittivity $\epsilon_r = 3 - j1$. The frequency is 350 MHz. Find the impedance of the medium and the distance required to attenuate a wave by 20 dB after entering the medium. Take $\mu_r = 2 - j3$.