

Introduction to Electric and Magnetic Fields B38EM

Tutorial #7

1. A plane wave traveling along the x -axis in a polystyrene-filled region with $\epsilon_r = 2.54$ has an electric field given by $E_y = E_0 \cos(\omega t - kx)$. The frequency is 2.4 GHz, and $E_0 = 5.0$ V/m. Find the following:

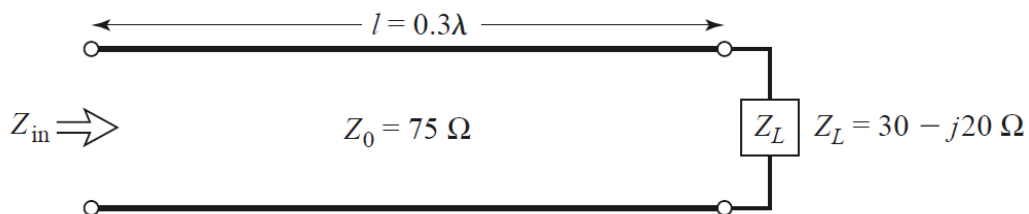
- (a) the amplitude and direction of the magnetic field,
- (b) the phase velocity,
- (c) the wavelength,
- (d) the phase shift between the positions $x_1 = 0.1$ m and $x_2 = 0.15$ m.

2. A 75Ω coaxial line has a current $i(t, z) = 1.8 \cos(3.77 \times 10^9 t - 18.13z)$ mA. Determine:

- (a) the frequency,
- (b) the phase velocity,
- (c) the wavelength,
- (d) the relative permittivity of the line,
- (e) the phasor form of the current, and
- (f) the time domain voltage on the line.

3. A transmission line has the following per-unit-length parameters: $L = 0.5 \mu\text{H/m}$, $C = 200$ pF/m, $R = 4.0 \Omega/\text{m}$, and $G = 0.02$ S/m. Calculate the propagation constant and characteristic impedance of this line at 800 MHz. If the line is 30 cm long, what is the attenuation in dB? Recalculate these quantities in the absence of loss ($R = G = 0$).

4. A lossless transmission line of electrical length $\ell = 0.3 \lambda$ is terminated with a complex load impedance as shown in the accompanying figure. Find the reflection coefficient at the load, the SWR on the line, the reflection coefficient at the input of the line, and the input impedance to the line.



5. A 75Ω coaxial transmission line has a length of 2.0 cm and is terminated with a load impedance of $37.5 + j75 \Omega$. If the relative permittivity of the line is 2.56 and the frequency is 3.0 GHz, find the input impedance to the line, Z_{in} , the reflection coefficient, Γ and the SWR on the line.

6. A lossless transmission line is terminated with a $100\ \Omega$ load. If the SWR on the line is 1.5, find the two possible values for the characteristic impedance of the line.

7. A radio transmitter is connected to an antenna having an impedance $80 + j40\ \Omega$ with a $50\ \Omega$ coaxial cable. If the $50\ \Omega$ transmitter can deliver 30 W when connected to a $50\ \Omega$ load, how much power is delivered to the antenna?