EE 481/581 Microwave Engineering (Fall 2024)

Homework 3

Monday, September 16, 2024

1) A Victorian brass and beeswax coaxial transmission line operates at 2.5 GHz has the distributed parameters $R = 4\ \Omega$/m, $L = 264$ nH/m, $G = 4.1$ mS/m, and $C = 105$ pF/m. Calculate the 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 (m/s and fraction of c).
2) Use a 2 m length of the Victorian coaxial transmission line to create a TL circuit with $V_g = 20\angle 0°$ V, $Z_g = 50 - j10\ \Omega$, and $Z_L = 100 - j50\ \Omega$ operating at 2.5 GHz. Find: a) the load reflection coefficient, b) input reflection coefficient, c) V_0^+, d) the general phasor voltage & current equations.
3) Use information from problem 2) to find the **exact**: a) input power, b) load power, c) power lost in TL, d) power from generator, and e) power consumed by Z_g.
4) Repeat problem 3) to get low-loss TL approximations for: a) input power, b) load power, and c) power lost in TL. Compare with problem 3) answers.
5) A lossless transmission line (75 Ω, 2.1×10^8 m/s) of length 10 cm has a measured input impedance of $16.5 - j34.5\ \Omega$ at 4.6 GHz. Using a Smith chart, find: a) input reflection coefficient, b) input admittance, c) load reflection coefficient, d) SWR, e) return loss, and f) load impedance.
6) 2.20
7) 2.23 Use Smith Chart.
8) 2.29 Analytic solution. Find both P_{in} and P_{Vg}.
9) EE 581 only- Using computer, plot $|V|$, $|I|$, and P for $-\ell/\lambda \le z/\lambda \le 0$ for problem 2.29.

- Where relevant, one Smith chart per problem. **Clearly label** all work on Smith charts (e.g., label all points, arcs, problem number, distances, …).
- Put all complex quantities in phasor form (e.g., $A/\theta°$) except admittances, impedances and propagation constants which should be in rectangular form.

Due Friday, September 20, 2024.