EE 481/581 Microwave Engineering (Fall 2025)

Homework 3

Monday, September 15, 2025

1) A coaxial transmission line, operating at 3.6 GHz, has the distributed parameters $R = 3.8\ \Omega$/m, $L = 248$ nH/m, $G = 6.4$ mS/m, and $C = 112$ 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 1 m length of the coaxial transmission line from 1) to create a TL circuit with $V_g = 16\angle 0°$ V, $Z_g = 45 - j10\ \Omega$, and $Z_L = 100 - j50\ \Omega$ operating at 3.6 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 ($50\ \Omega$, 2.4×10^8 m/s) of length 15 cm has a measured input impedance of $18 + j32\ \Omega$ at 2 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 Change load to $40 - j70\ \Omega$
7) 2.23 Change SWR to 3. Use Smith Chart.
8) 2.29 Change attenuation to 0.6 dB/ λ and TL length to 1.8λ. Find both P_{in} and P_{Vg}. Analytic solution.
9) EE 581 only- 2.17

Due Friday, September 19, 2025.

- Where relevant, one Smith chart per problem. **Clearly label** all work on Smith charts (e.g., label Z_0, f & v_p or λ, all points, arcs, problem number, distances, …).
- Put all complex quantities in phasor form (e.g., $A/\underline{\theta°}$) except admittances, impedances and propagation constants which should be in rectangular form.