EE 481/581 Microwave Engineering (Fall 2024)
Homework 5
Wednesday, September 25, 2024

1) A lossless transmission line (75 Ω, 1.98×10^8 m/s) of length 10 cm connects a load of $16.5 - j34.5$ Ω to a matched 10 V generator operating at 2.2 GHz. Using a Smith chart, find the unmatched input impedance and load power. Then, design and sketch a shunt single-stub tuning network with short circuit termination. Place the stub as close as possible to the load and make the stub as short as possible. Find the matched input impedance and load power.

2) For a circuit operating at 100 MHz, design and sketch a series single-stub with open circuit termination tuning network for a load $Z_L = 100 + j150$ Ω connected to a lossless transmission line (250 Ω, 2×10^8 m/s) using a Smith chart. Place the stub as close as possible to the load and make the stub as short as possible.

3) A lossless transmission line (75 Ω, 1.98×10^8 m/s) has a load of $16.5 - j34.5$ Ω at 2.2 GHz. Design and sketch a quarter-wave transformer (QWT), using a Smith chart, to match the load with the QWT placed as close as possible to the load. Assume that the QWT section has a phase velocity of 2.08×10^8 m/s.

4) EE 581 only: For QWT problem, estimate the fractional bandwidth (express as a percentage) of the QWT with the specification that the SWR ≤ 1.25.

Due Monday, September 30, 2024.

- Where relevant, one Smith chart per problem. **Clearly label** all work on Smith charts (e.g., label problem number, Z_0, f or λ, all points, arcs, distances, …).

- Put all complex quantities in phasor/polar form (e.g., $A\angle\theta°$) except admittances, impedances, and propagation constants which should be in rectangular form.