EE 481/581 Microwave Engineering (Fall 2025)
Homework 4
Friday, September 26, 2025

1) For a circuit operating at 800 **M**Hz, design and sketch a single parallel capacitor matching network for a load $Z_L = 45 + j60\ \Omega$ connected to a lossless transmission line (75 Ω, 2.4×10^8 m/s). Use Smith chart solution method.

2) For a circuit operating at 200 MHz, design and sketch a lossless *L*-network using a parallel capacitor to match a load $Z_L = 120 - j120\ \Omega$ to a lossless transmission line (60 Ω, 2.5×10^8 m/s). Use Smith chart solution method and give component values to 3 significant figures. Confirm component values using analytic equations.

3) A lossless transmission line (300 Ω, 2×10^8 m/s) of length 36 cm connects a load of $240 - j180\ \Omega$ to a matched 16 V generator operating at 1 GHz. Using a Smith chart, find the unmatched input impedance and load power. Then, design and sketch a shunt single-stub tuning network with an open 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.

4) A lossless transmission line (40 Ω, 2.6×10^8 m/s) has a load $Z_L = 26 + j18\ \Omega$ at 1.04 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 2.5×10^8 m/s.

5) A lossless transmission line (300 Ω, 2×10^8 m/s) of length 125 cm connects a load of $180 + j240\ \Omega$ to a matched 16 V generator operating at 500 MHz. Using a Smith chart, find the unmatched input impedance and load power. Then, design and sketch a shunt double-stub tuning network with short circuit terminations. Place the stubs at λ/8 intervals and make the stubs as short as possible. Find the matched input impedance and load power.

6) **EE 581 only:** For problem 2), using the *L*-network designed with a Smith chart, calculate the component impedances, input impedance at terminals of matching network, input reflection coefficient, and SWR at 180, 200, & 220 MHz. **Tabulate** results with col. 1 f (MHz), col. 2 Z_{cap}, col. 3 Z_{ind}, col. 4 Z_{in}, col. 4 Γ_{in}, & col. 5 SWR.

Due Wednesday, October 1, 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.