EE 483/583 Antennas for Wireless Communications (Spring 2026)
Homework 8
Friday, March 13, 2026

1) Match the **five**-element Yagi-Uda antenna (channel 13) from the prior assignment **with the boom omitted** to a **100 Ω** twin-lead transmission line using a **T-match** so that the VSWR < 1.1. Steps:
   a) Tabulate the element spacings and lengths (in cm) for the **unmatched design** (make driven element length the simple average of the reflector and first director).
   b) Model **unmatched design** using NEC-2. Find and tabulate input impedance Z_{in}, input reflection coefficient Γ_{in} (polar format w/ angle in deg), VSWR, maximum gain G_{max} (dBi), backlobe gain G_{back} (dBi), and front-to-back/FB ratio (dB) at f_c.
   c) Match the antenna. At each step, discuss, list, and justify design changes/choices as well as show results/work.
   d) In a **table**, summarize the original (unmatched) and final (matched)- Z_{in}, Γ_{in}, VSWR, G_{max} (dBi), G_{back} (dBi), and FB ratio (dB) at f_c. Comment on how the final design compares with the original.
   e) Accurately sketch final antenna design with T-match (no boom).
      - Use NEC-2 to find the antenna-mode input impedance(s). Include the input file(s) and relevant excerpts of output file(s). Place antenna on y-z plane with elements spaced & centered along the positive z-axis with the reflector at $z = 0$.

2) At 102 MHz, match an antenna ($Z_A = 300 - j450\ \Omega$) to a feeding transmission line ($Z_0 = 300\ \Omega$ & $u = 2.1 \times 10^8$ m/s) using a discrete inductor connected in parallel as close to the antenna as possible. Draw a fully labeled sketch of final design.

3) At 600 MHz, match an antenna ($Z_A = 20 - j\ 50\ \Omega$) to a feeding transmission line ($Z_0 = 50\ \Omega$ & $u = 2.4 \times 10^8$ m/s) using a discrete capacitor connected in series as close to the antenna as possible. Draw a fully labeled sketch of final design.

4) At 102 MHz, match an antenna ($Z_A = 300 - j450\ \Omega$) to a feeding transmission line ($Z_0 = 300\ \Omega$ & $u = 2.1 \times 10^8$ m/s) using a stub of the same transmission line with an open-circuit termination. Place the stub as close to the antenna as possible and make the stub as short as possible. Draw a fully labeled sketch of final design.

5) At 200 MHz, match an antenna ($Z_A = 42 + j\ 39\ \Omega$) to a feeding transmission line ($Z_0 = 60\ \Omega$ & $u = 2.4 \times 10^8$ m/s) using a quarterwave transformer (QWT) placed as close to the antenna as possible. Assume the wavelength λ' of the QWT is 110% of λ for the feeding transmission line. Draw a fully labeled sketch of final design.

6) **EE 583 only:** For the match of problem 3, analytically find the input impedance Z_{in}, reflection coefficient Γ_{in}, & VSWR at 575, 600, & 625 MHz on feeding transmission line just past the capacitor toward the generator. Tabulate results (col. 1 frequency, col. 2 Z_{in} (rectangular format), col. 2 Γ_{in} (polar w/ angle in deg), col. 4 VSWR).

Due Wednesday, March 25, 2026.

Note: Assume $c = 2.998 \times 10^8$ m/s. Include Smith charts w/ each problem needing them.