EE 483/583 Antennas for Wireless Communications (Spring 2022)
Homework 9
Wednesday, March 23, 2022

1) Match the channel 10 six-element Yagi-Uda antenna from the previous assignment <u>with the boom omitted</u> to a **100 Ω** twin-lead transmission line using a **T-match** so that the VSWR is less than 1.1 at the center frequency. At each step, discuss and justify design changes/choices. Accurately sketch final design. In a table, summarize the original (unmatched) and final Yagi-Uda input impedance, input reflection coefficient (polar format), VSWR, gain (dBi), and front-to-back ratio (dB). Comment on how the final design compares with the original.

   - Use NEC-2 to find the antenna-mode input impedance(s). Include the input file(s) and relevant excerpts of the output file(s). Assume $c = 2.998 \times 10^8$ m/s.

2) An antenna has input impedance $Z_A = 37.5 - j\,75$ Ω at 100 MHz. Match it to a feeding transmission line ($Z_0 = 75$ Ω & $u = 2.25 \times 10^8$ m/s) using a discrete <u>inductor</u> connected in parallel as close to the antenna as possible. Draw a fully labeled sketch of the final design.

3) An antenna has input impedance $Z_A = 37.5 - j\,75$ Ω at 100 MHz. Match it to a feeding transmission line ($Z_0 = 75$ Ω & $u = 2.25 \times 10^8$ m/s) using a stub of the same transmission line with a short-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 the final design.

4) An antenna has input impedance $Z_A = 50 - j\,45$ Ω at 1 GHz. Match it to a feeding transmission line ($Z_0 = 50$ Ω & $u = 2.1 \times 10^8$ m/s) using a quarterwave transformer (QWT) placed as close to the antenna as possible. Assume the wavelength λ' of the QWT is 92% of λ for the feeding transmission line. Draw a fully labeled sketch of the final design.

5) EE 583 only: For the match of problem 2, <u>analytically</u> find the input impedance Z_{in}, reflection coefficient Γ, and VSWR at 95, 100, & 105 MHz on the feeding transmission just past the inductor toward the generator assuming Z_A remains constant. Tabulate results- col. 1 frequency, col. 2 Z_{in} (rectangular format), col. 3 Γ (polar format), and col. 4 VSWR.

Due Monday, March 28, 2022.

Notes:

   - For each problem using a Smith chart, include a *separate*, **fully labeled** one.