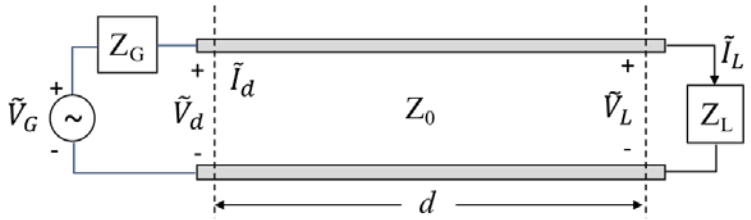
ELEN 3401 Electromagnetics
Problem Set #3

DUE: Friday Feb. 21
Please include your name and UNI on the assignment

Problem 1: Voltage and Current along Transmission Line

A lossless transmission line of characteristic impedance Z_0 = 50 Ω and length d = 17 m is connected to an unknown load Z_L and to a generator $\tilde{V}_G$ = 10∠0° volts as shown in the figure below. The internal impedance Z_G, of the generator is unknown. The signal wavelength on the line is λ = 8 m. The current and voltage on the line at the generator end are measured and found to be $\tilde{I}_d$ = 40∠0° mA and $\tilde{V}_d$ = 6∠0° volts.



a. Determine the wave impedance Z_d at the generator end, as well as the generator's internal impedance Z_G.
b. Determine the load impedance Z_L.

Problem 2: Standing Wave Ratio

Consider a lossless transmission line with a characteristic impedance of 100-Ω that is terminated with an unknown load impedance. The line is operated at a frequency corresponding to a wavelength λ = 40 cm. The standing wave ratio along this line is measured to be S = 3. The distance from the load to the first voltage minimum is measured to be 5 cm.

Based on these two measurements, determine the unknown load impedance.

Problem 3: Power Flow in Lossless Transmission Line

An antenna with a load impedance*:* Z_L = (75+ j25) Ω is connected to a transmitter through a 50Ω lossless transmission line. If under matched conditions the transmitter can deliver 46W to the load, obtain the power that can be delivered to the antenna. Assume that $Z_g = Z_0$.

Problem 4: Transients on Transmission Lines

We have a 1 m long lossless line characterized by $Z_0 = 50\ \Omega$ and $u_p = 2c/3$ (where c is the velocity of light). The line is fed by a step voltage applied at $t = 0$ by a generator circuit with $V_g = 60$ V and $R_g = 100\ \Omega$. The line is terminated in a load with $R_L = 25\ \Omega$.

a) Generate a bounce diagram for the voltage $V(z, t)$ on this line.
b) Use the bounce diagram to plot $V(t)$ at a point midway (50 cm) along the length of the line from $t = 0$ to $t = 25$ ns.
c) Find the steady-state voltage on the line.