NAME _____ NETID _____

MIDTERM EXAM

ECE 451

March 10, 2025

12:00 – 12:50 pm

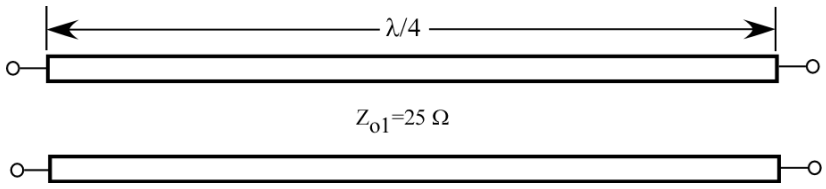
Instructions: Write your name and NetID where indicated. This examination consists of 3 problems. This is an open-book and open-notes exam. Use 50 Ω as the reference impedance for all measurement systems.

Problem 1 (40 pts)	Problem 2 (40 pts)	Problem 3 (20 pts)	Total (100 pts)

Mason's non-touching loop rule:

$$T = \frac{P_1\left[1 - \sum L(1)^{(1)} + \sum L(2)^{(1)} - \ldots\right] + P_2\left[1 - \sum L(1)^{(2)} + \sum L(2)^{(2)} - \ldots\right] + \ldots}{1 - \sum L(1) + \sum L(2) - \sum L(3) + \ldots}$$

1. For the transmission line shown below, write the scattering parameter matrix as measured on a 50-Ω network analyzer.

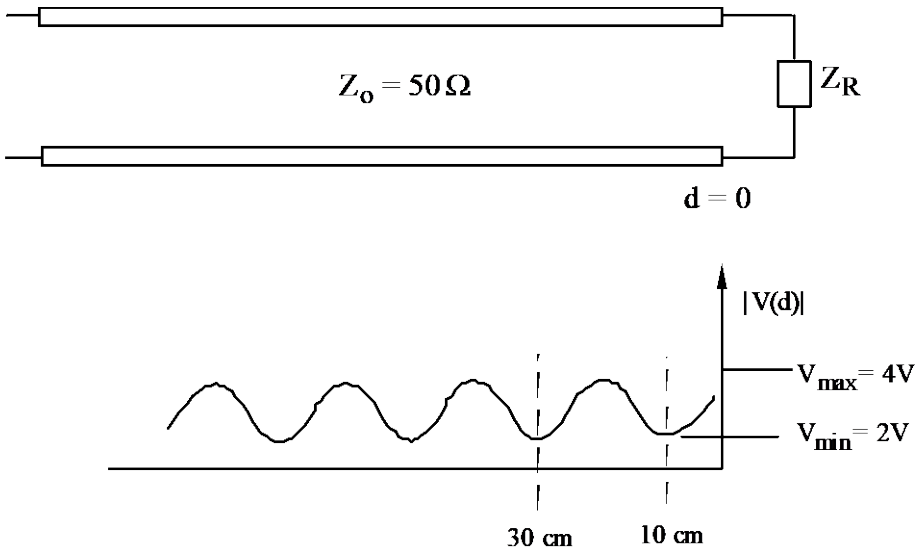


2. A transmission line of characteristic impedance Z_o, length d and propagation constant β is terminated with an open.

   (a) Find the input impedance.

   (b) Draw a rough sketch of Z_{in}/Z_o for βd ranging from 0 to π and label the frequency bands where the transmission line looks capacitive and where it looks inductive.

   (c) At what frequencies does this open transmission line look like a short circuit?



2. A slotted line is made of coaxial conductors with air as the dielectric. The characteristic impedance is 50 Ω. When a load Z_R is connected to the slotted line, the voltage magnitude is that of the plot shown in the figure.

   (a) What is the frequency of the signal ?

   (b) What is the value of Z_R ?