UNIVERSITY ☺F P☺RTLAND
Sch☺☺l ☺f Engineering

EE 301-Electromagnetic Fields-3 cr. hrs.
Spring 2003

Midterm Exam # 2

(Prepared by Professor A. S. Inan)

(Monday, April 14, 2003)
(Closed Book Exam; Formula Sheets Allowed)
(Total Time: 55 mins.)

Name:_____ _____ _____☺

Signature:_____ _____ _____ ☺

"Honesty is the best policy."
Aesop (~ 620B.C. - ?)

"An honest mind possesses a kingdom."
Lucius Annaeus Seneca (4B.C. - 65A.D.)

"Honest people are the true winners of the universe."
Anonymous

Points lost on each problem:

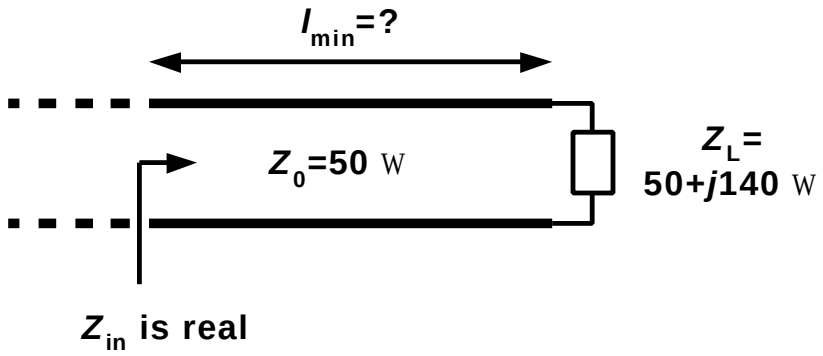
#1 _____

#2 _____

#3 _____

#4 _____

(1) (Total time: 10 mins.) **Real Z_{in} position.** Consider the transmission-line circuit shown. Assume sinusoidal steady-state conditions to apply. Find the following:

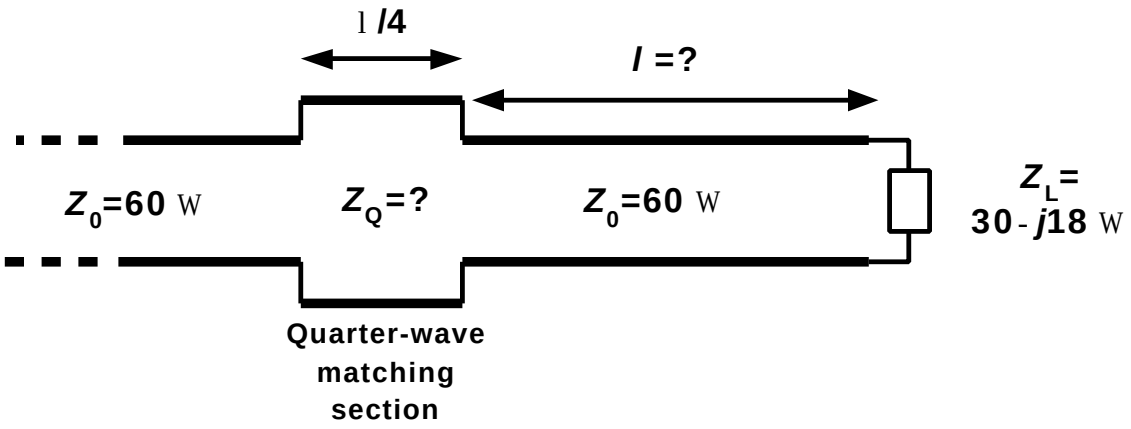


(a) (5 points) The electrical position nearest to the load where the input impedance of the transmission line is purely resistive. (You are welcome to use the Smith chart on the next page.)

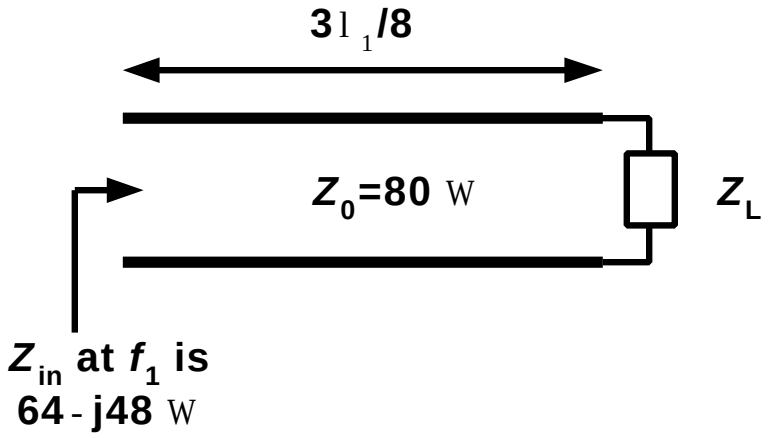
(b) (5 points) The approximate value of Z_{in} at that position.

(c) (5 points) The approximate value of the standing-wave-ratio S on the line.

(2) (10 mins., 25 points) **Quarter-wave transformer design.** Consider the transmission-line circuit as shown. Design the quarter-wave transformer matching network shown (i.e., determine its electrical position l away from the load and its characteristic impedance Z_Q) to match Z_L to Z_0 such that $Z_Q > Z_0$. (Assume sinusoidal steady-state condition to apply.)



(3) (10 mins., 30 points) **The input impedance of a transmission line.** In the transmission-line circuit shown, the load impedance is unknown. The input impedance of the line is measured to be $Z_{in} = 64\text{-}j48\ \Omega$ at source frequency f_1. Assuming both Z_L and Z_0 values to be independent of the source frequency, find the input impedance Z_{in} of the line at source frequency $f_2 = 2f_1$. (Assume sinusoidal steady-state condition to apply.)



(4) (15 mins., 30 points) **Distributed matching network design.** Consider the transmission-line circuit as shown. As a design engineer, your task is to determine the electrical lengths of the two short-circuited stubs (each 50 **Ω**) connected at the load position as shown so that not only you match Z_L to Z_0 but you also keep the total stub length l_s+l_p minimum. Assume sinusoidal steady state. (Note the order in which the stubs are connected. **DO NOT CHANGE THAT ORDER!!**)