University ☺f P☺rtland
Sch☺☺l ☺f Engineering

EE 301-Electromagnetic Fields-3 cr. hrs.
Spring 2014

Midterm Exam # 2
Sinusoidal Steady-State Waves on Transmission Lines

(Prepared by Professor A. S. Inan)

(Monday, April 4, 2014)
(Closed Book Exam; 3 Formula Sheets Allowed)
(Total Time: 55 mins.)

Name:_____ _____ _____☺

***Signature:*_____ _____ _____☺**

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

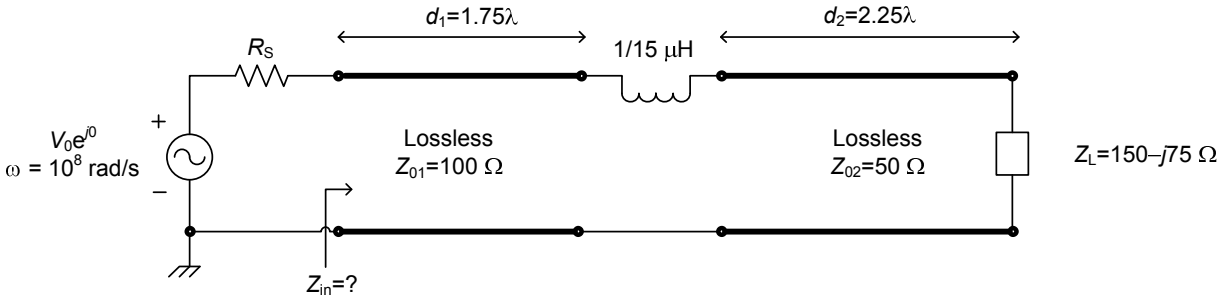
"An honest mind possesses a kingdom."
Lucius Annaeus Seneca (4B.C.–65A.D.)

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

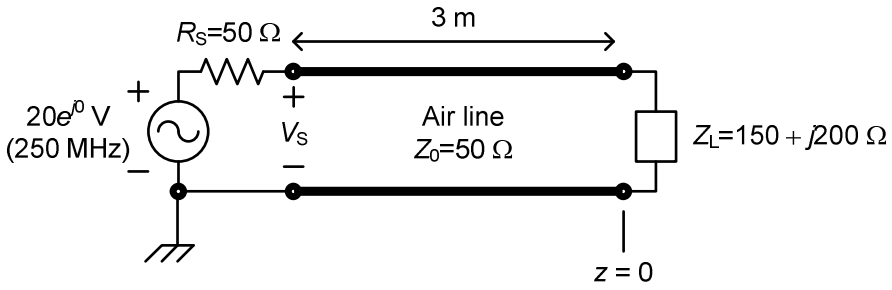
This table will be used by Inan for grading!

Problem #	Points gained
#1	
#2	
#3	
#4	
Total	

(1) (10 mins., 20 points) **Input impedance of a transmission-line circuit.** For the double transmission-line circuit shown, find the input impedance Z_{in} at $\omega = 10^8$ rad-s^{-1}.



(2) (15 mins., Total: 40 points) **A lossless transmission line terminated with a complex impedance.** A $50\,\Omega$ air transmission line is terminated with an inductive load impedance given by $Z_L = 150 + j200\,\Omega$ and excited by a sinusoidal voltage source as shown.



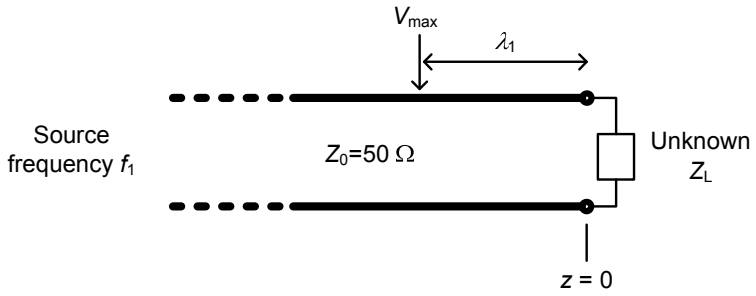
(a) (10 points) Calculate the load reflection coefficient Γ_L. (Provide your answer in polar form.) Show your work!

(b) (5 points) What is the value of the standing wave ratio *S* on the line?

(c) (15 points) Calculate the time-average power delivered to the load.

(d) (10 points) Find the first two V_{max} and the first two V_{min} positions nearest to the position of the load on this transmission line. Provide your answers in units of distance.

(3) (10 mins., 20 points) **Unknown load.** The standing wave ratio on a 50 Ω transmission line excited at f_1 frequency and terminated with an unknown load Z_L is measured to be 5. If a voltage maximum position on the line is located at λ_1 distance away from the load position, determine the value of the load impedance Z_L. (Note that λ_1 is the wavelength at source frequency f_1.)



(4) (10 mins., 20 points) **Unknown load.** A 50 Ω air transmission line with a standing wave ratio of S = 2.5 has its first voltage minimum and maximum positions on the line nearest to the load at 0.15 m and 0.45 m respectively. Calculate (a) the operating frequency f; and (b) the load impedance Z_L.