University of Portland
School of Engineering

EE 301-Electromagnetic Fields-3 cr. hrs.
Spring 2017

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

(Prepared by Professor A. S. Inan)

(Wednesday, April 12, 2017)
(Closed Book Exam; 2 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.)

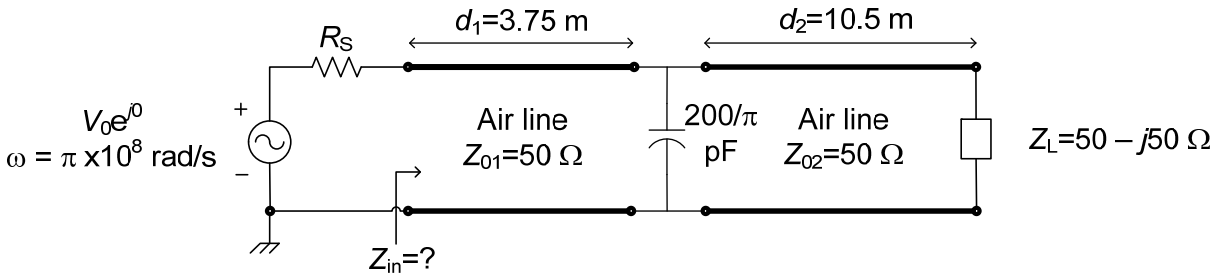
"Honest people are the true winners of the universe."
Anonymous

Important: Note that Problem (2) is expected to be done fully in class. However, any two of the other three Problems (1), (3) and (4) are expected to be done in class and the third one of your choice is expected to be done as a take-home problem. The take-home problem is due to the next class meeting (Thursday, April 13, 2017, before noon).

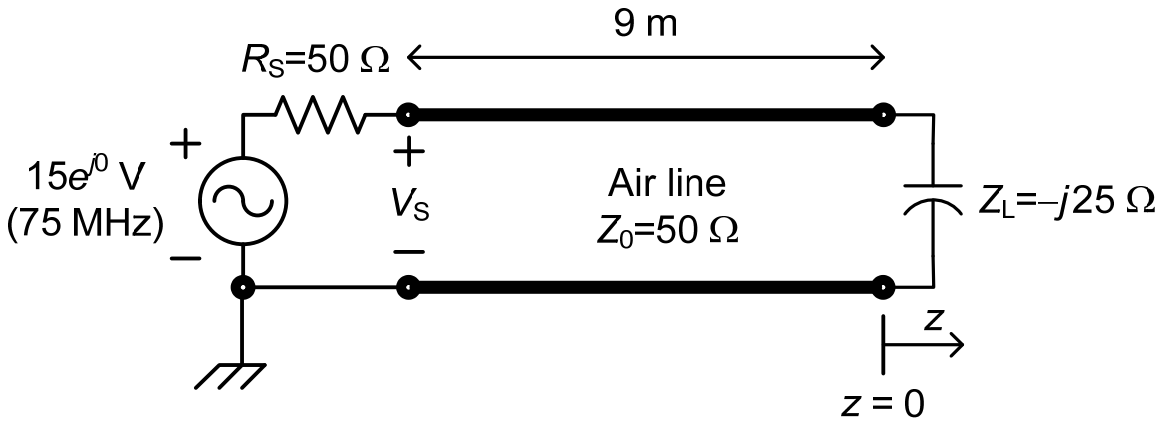
This table will be used by Inan for grading!

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 $\omega = \pi \times 10^8$ rad-s^{-1}. Note that the capacitor between the two lines is a lumped element.



(2) (15 mins., Total: 40 points) **A lossless transmission line terminated with a complex impedance.** A 9 m long, 50 Ω air transmission line is terminated with a purely reactive load impedance given by $Z_L = -j25$ Ω 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!

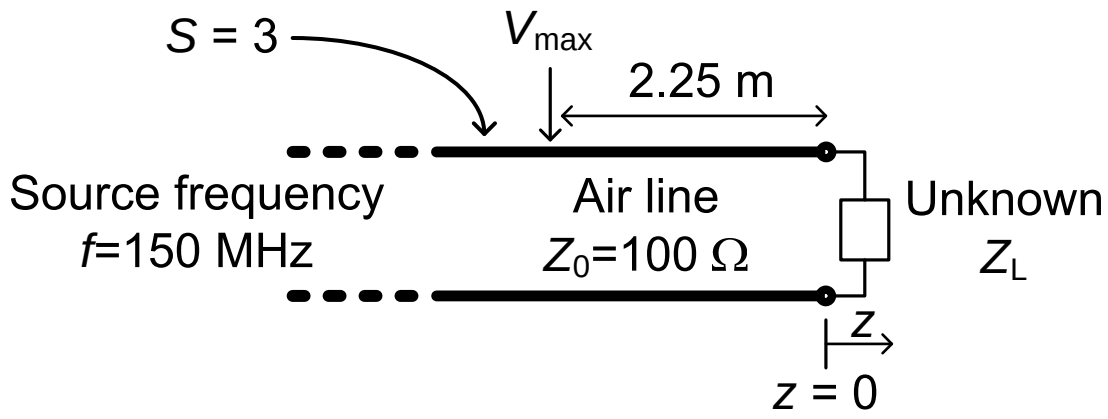
(b) (5 points) What is the value of the standing wave ratio S on this transmission line?

(c) (10 points) Find the source-end phasor voltage V_S in polar form.

(d) (5 points) Calculate the percentage of the time-average power carried by the incident wave that reflects back to the source.

(e) (10 points) Find all the V_{max} and the V_{min} positions with respect to the load position $z = 0$ on this transmission line. Provide your answers in a table in units of distance.

(3) (10 mins., 20 points) **Unknown load.** The standing wave ratio on a 100 Ω air transmission line excited at an operating frequency of 150 MHz and terminated with an unknown load Z_L is measured to be 3. If one of the voltage maximum positions on this line is located at a distance of 2.25 m away from the load position, determine the value of the load impedance Z_L.



(4) (10 mins., 20 points) **Unknown load.** A 75 Ω air transmission line with a standing wave ratio of $S = 7$ has its first minimum and maximum positions nearest to the load at 30 cm and 90 cm, respectively. Calculate (a) the operating frequency f; and (b) the load impedance Z_L.