

University of Portland
School of Engineering

EE 301-Electromagnetic Fields-3 cr. hrs.
Spring 2012

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

(Prepared by Professor A. S. Inan)

(Wednesday, April 18, 2012)

(Closed Book Exam; Formula Sheets Allowed)

(Total Time: 55 mins.)

Did you know that yesterday was the 222nd anniversary of Benjamin Franklin's death? (He died on April 17, 1790, at age 84.) I put together a quick brainteaser math puzzle for you on this matter. If you multiply number 222 by the product of its digits (i.e., $2 \times 2 \times 2$), what comes out? I hope you know the significance of the result.

Name: _____ ☺

Signature: _____ ☺

“Honesty is the best policy.”

Aesop (~ 620B.C. -?)

“An honest mind possesses a kingdom.”

Lucius Annaeus Seneca (4B.C.-65A.D.)

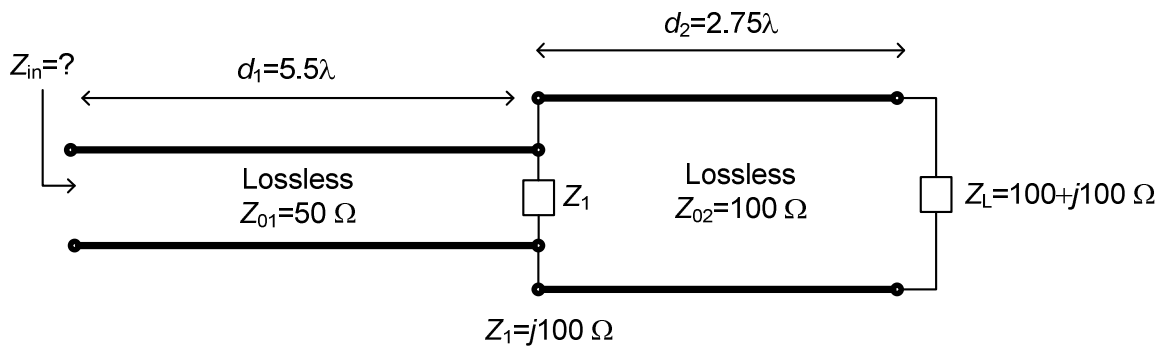
“Honest people are the true winners of the universe.”

Anonymous

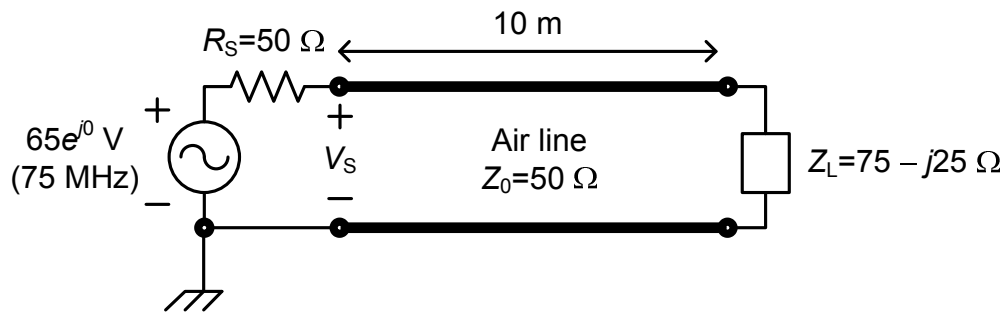
This table will be used by Inan for grading!

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} . Assume both impedances Z_1 and Z_L to be lumped elements.



- (2) (15 mins., Total: 40 points) **A lossless transmission line terminated with a complex impedance.** A $50\ \Omega$ air transmission line is terminated with a capacitive load impedance given by $Z_L = 75 - j25\ \Omega$ 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 all the V_{\max} and V_{\min} positions on this line. Provide your answers in units of distance.

(3)(10 mins., 20 points) **Unknown load.** The standing wave ratio on a 50Ω transmission line feeding an unknown load antenna is measured to be 2 and one of the voltage minimums on the line is located at 0.08λ away from the load position. Determine the value of the antenna load impedance Z_L .

(4)(10 mins., 20 points) **Unknown load.** A 100Ω air transmission line with a standing wave ratio of $S = 4$ has its first and second voltage maximums located at 0.5 m and 2 m with respect to the load position. Calculate (a) the operating frequency f ; and (b) the load impedance Z_L .

