*University of Portland*
*School of Engineering*

# EE 301-Electromagnetic Fields-3 cr. hrs.
# Spring 2007

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

(Prepared by Professor A. S. Inan)

(Monday, April 16, 2007)
(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.)**

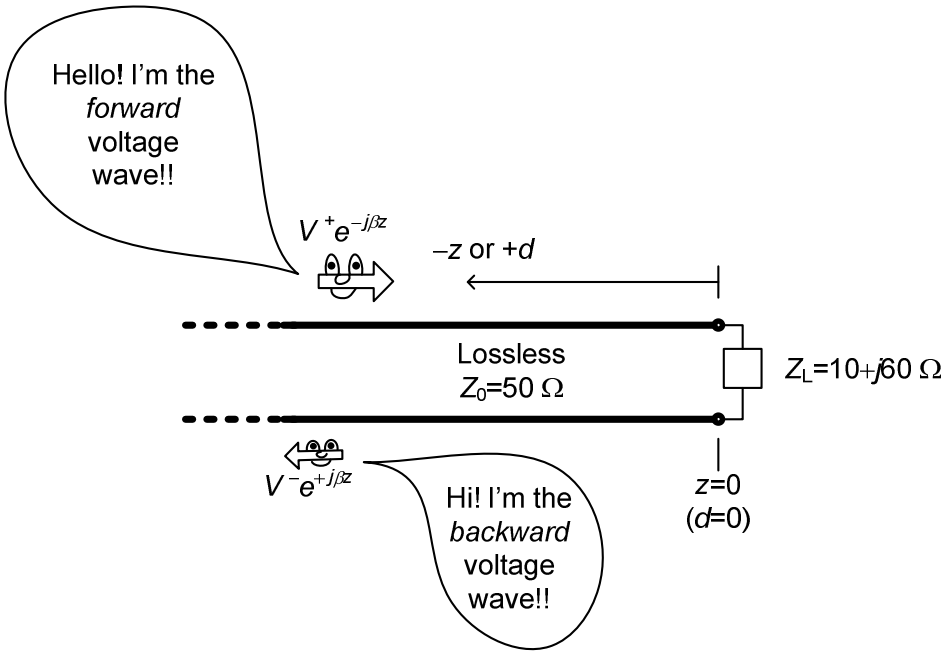
***"Honest people are the true winners of the universe."***
**Anonymous**

***"Honesty is not for sale."***
**A. Inan**

***This table will be used by Inan for grading!***

| Problem # | Points gained |
|---|---|
| #1 | |
| #2 | |
| #3 | |
| Total | |

(1) (*15 mins., <u>Total:</u> 40 points*) **A lossless transmission line terminated with a complex impedance.** A $50\,\Omega$ transmission line is terminated with an inductive load impedance given by $Z_L = 10 + j60\,\Omega$, as shown.



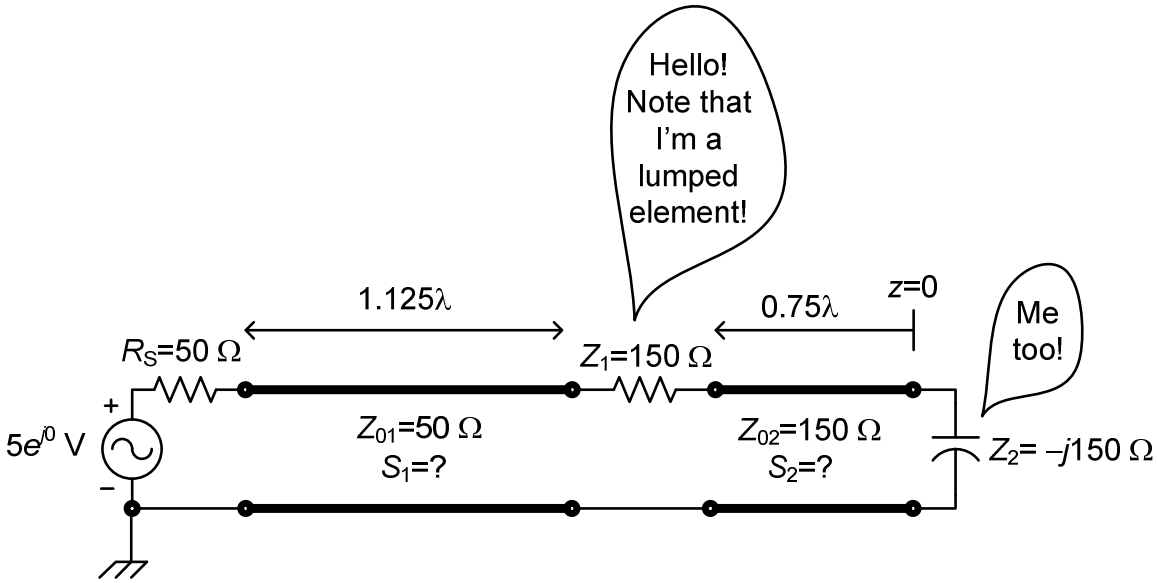

(a) (*10 points*) Find the load reflection coefficient, $\Gamma_L$. (Provide your answer in polar form.) Show your work!

(b) (*10 points*) What is the value of the standing wave ratio, *S*, on the line? (Show your work!)

(c) (*10 points*) Calculate the percentage time-average incident power that reflects back from the load.

(d) (*10 points*) Find the $V_{max}$ and $V_{min}$ positions nearest to the load. Provide your answers as electrical lengths.

(2) (*15 mins.*, *Total: 30 points*) **Two cascaded transmission lines.** Consider the transmission line circuit as shown. Assume lossless lines.




(a) (*15 points*) Find the standing wave ratio on each line. Show your work!

(b) (*15 points*) Find the time-average power delivered to each impedance $Z_1$=150 Ω and $Z_2$= −$j$150 Ω.

(3) (*15 mins., <u>Total:</u> 30 points*) **Unknown load impedance.** Consider a 50 Ω transmission line terminated with an unknown load $Z_L$. If the standing-wave ratio on the line is measured to be S ≅ 4.2 and the nearest voltage minimum point with respect to the load is located at $0.21\lambda$, find the following:

(a) (*10 points*) The load impedance $Z_L$. Show your work step by step.

(b) (*10 points*) The nearest voltage maximum position to the load.

(c) (*10 points*) The input impedance $Z_{in}$ at the nearest voltage minimum and maximum positions found in parts (a) and (b).