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

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

Final Examination

(Prepared by Professor A. S. Inan)

(Thursday, May 1, 2003, 8:00-10:00a.m.)
(Closed Book Exam; Formula Sheets Allowed)

Name:_____ ☺

Signature:_____ ☺

"The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biased by appearances, have no favorite hypotheses, be of no school, and in doctrine have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities he add industry, he may indeed hope to walk within the veil of the temple of Nature."

"I do not feel that I possess anything extraordinary. If I do have the pleasure of a special talent it must certainly be perseverance."

Michael Faraday (1791 - 1867)

Points lost on each problem:

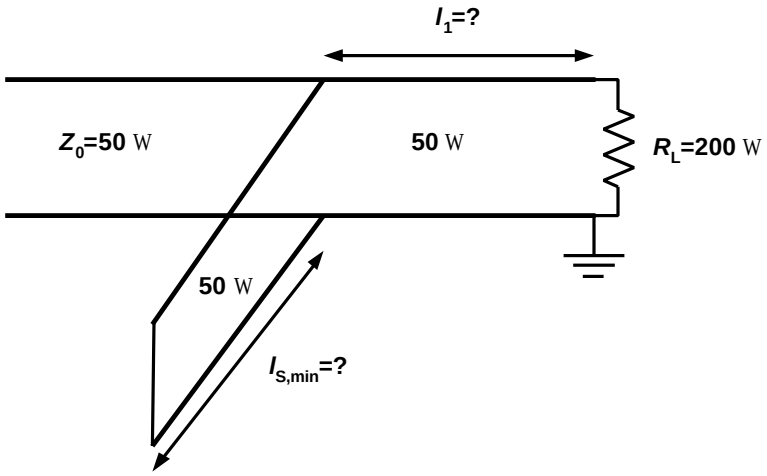
#1 _____

#2 _____

#3 _____

#4 _____

(1) (Total: 25 points) **Single shunt stub matching network design.** Design a single short-circuited shunt stub matching network with the shortest stub length to match a load impedance of $Z_L = 200\,\Omega$ to a transmission line with characteristic impedance $Z_0 = 50\,\Omega$.



(2) (Total: 25 points) **Uniform plane wave traveling in air.** Consider a uniform plane wave traveling in air with its electric field component given by

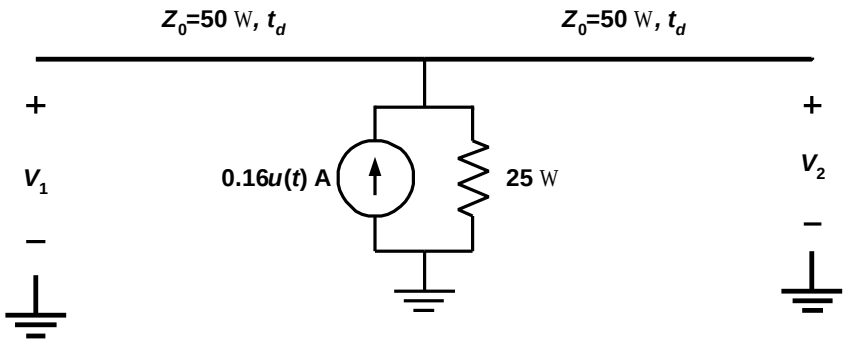
$$\vec{E}(x,t) = \hat{z}10\cos(wt - 10px) - \hat{y}20\sin(wt - 10px + p/3) \ \textbf{mV - m}^{-1}$$

(a) (8 points) Find the frequency f (in Hertz) and wavelength λ (in meters).

(b) (10 points) Find the corresponding magnetic field $\vec{H}(x,t)$. (Please provide your answer in its simplest form with the appropriate unit included.)

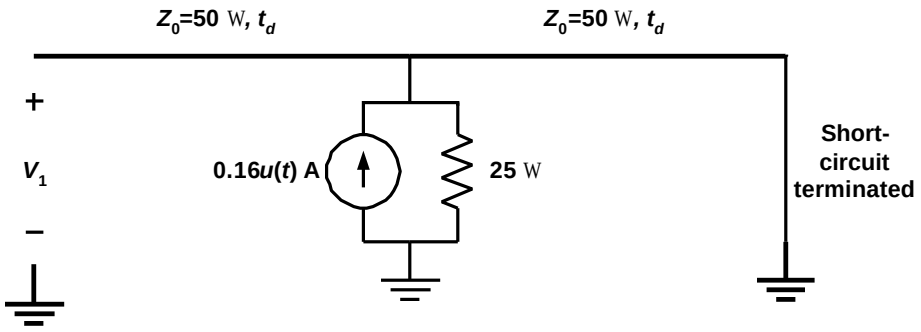
(c) (7 points) Find the total time-average power density carried by this wave.

(3) (Total: 25 points) **Step-source excitation of a parallel transmission line system.** Consider the transmission-line circuit shown.



(a) (10 points) Sketch the voltage $V_1(t)$ over the time interval $0 \le t \le 5t_d^+$. Provide a bounce diagram to support the $V_1(t)$ sketch.

(b) (15 points) Repeat part (a) for the following circuit. Again, please provide a bounce diagram.



(4) (Total: 25 points) **TDR display of the source-end voltage.** The source-end voltage of a transmission-line circuit terminated with an inductive load is obtained using a TDR system as shown. Using this sketch, find all the five unknown parameters in the circuit. Please show your work step by step.