

2/27/2004

UNIVERSITY ☺ OF PORTLAND
School ☺ of Engineering

EE 301-Electromagnetic Fields-3 cr. hrs.
Spring 2004

SOLUTIONS TO

Midterm Exam # 1

(Prepared by Professor A. S. Inan)

(Friday, February 27, 2004)

(Closed Book Exam; 1 Formula Sheet Allowed)

(Total Time: 55 mins.)

Name: SOLUTIONS! ☺

Signature: [Handwritten 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

Are you ready to take an Inan test? Are you worried?



Believe firmly in what you say... Believe firmly in what you say... Believe firmly...

Calm down, take it easy... And take a deep breath...



We will demonstrate Inan that we are not scared of his tests!!

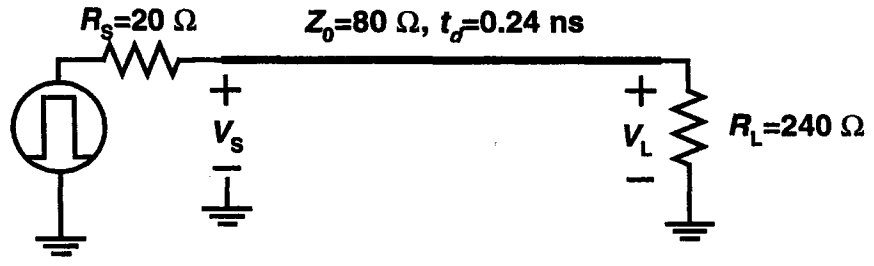
Attack and storm all problems made by Inan!!

2/27/2004

I hope what I say is true... we will see...

(1) (20 mins., 40 points) **Pulse excitation of a lossless transmission line.**
 For the transmission line circuit shown, sketch both the source-end and the load-end voltages as a function of time between $t = 0$ and $t = 1\text{ns}$.
 Provide all the relevant values on your sketches. Also provide a bounce diagram for your solution.

Inan's tests are nothing but a piece of cake...

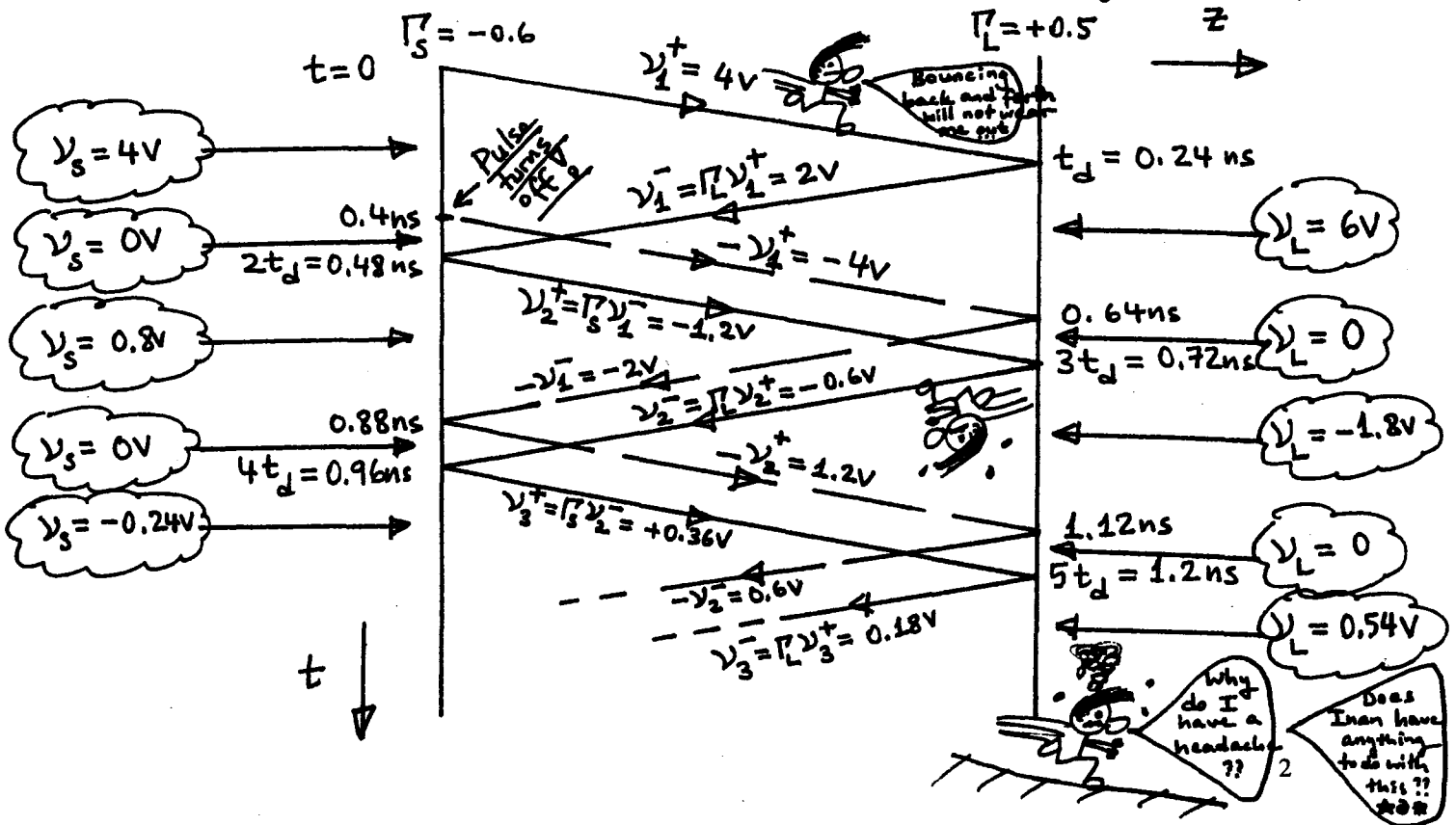


$$V_1^+ = \frac{Z_0}{R_s + Z_0} V_0 = \frac{80}{20 + 80} (5) = 4\text{V}$$

$$\Gamma_s = \frac{R_s - Z_0}{R_s + Z_0} = \frac{20 - 80}{20 + 80} = -0.6$$

$$\Gamma_L = \frac{R_L - Z_0}{R_L + Z_0} = \frac{240 - 80}{240 + 80} = +0.5$$

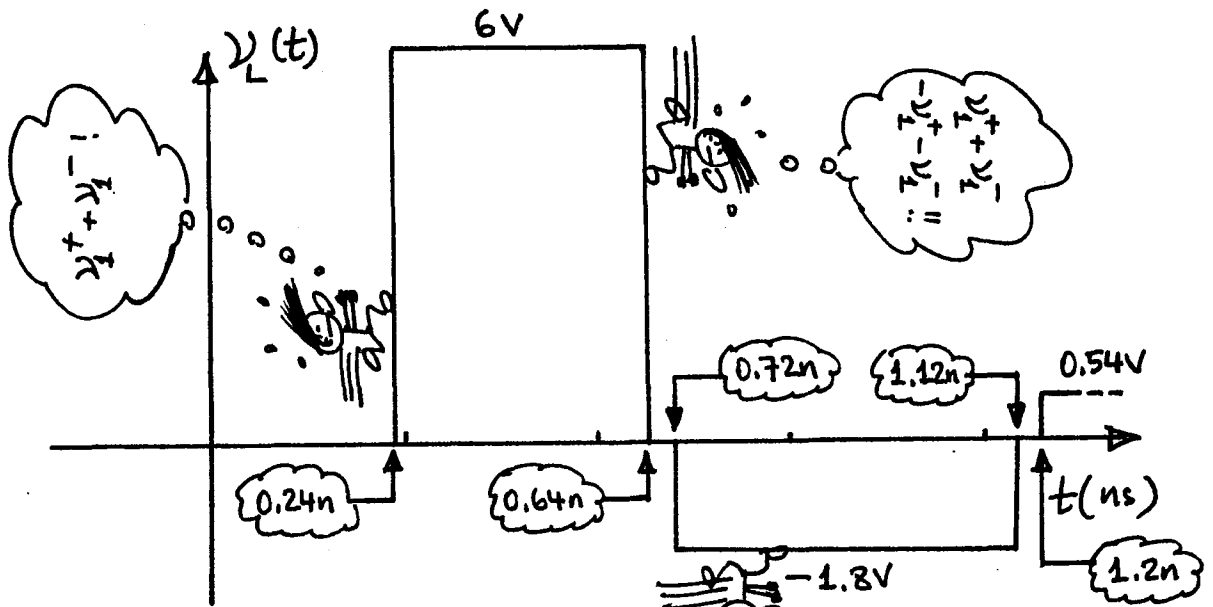
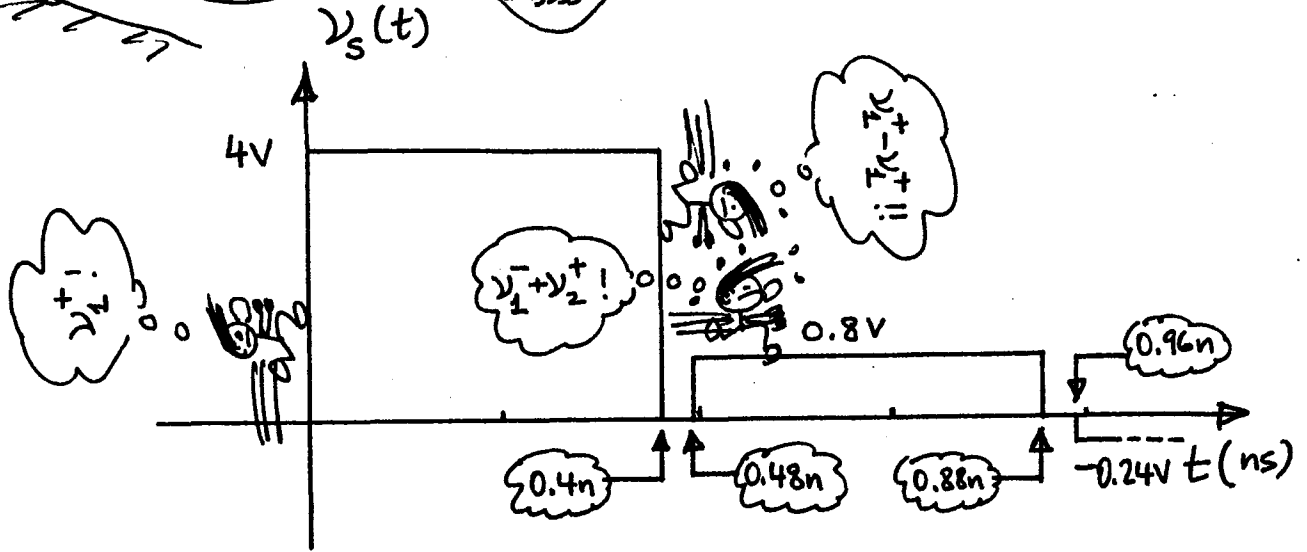
Plus Inan prepares us to tackle even the mother of all problems...



2/27/2004

I am glad I did a good job constructing the bounce diagram ...

Drawing the sketches from the bounce diagram is easyyy...



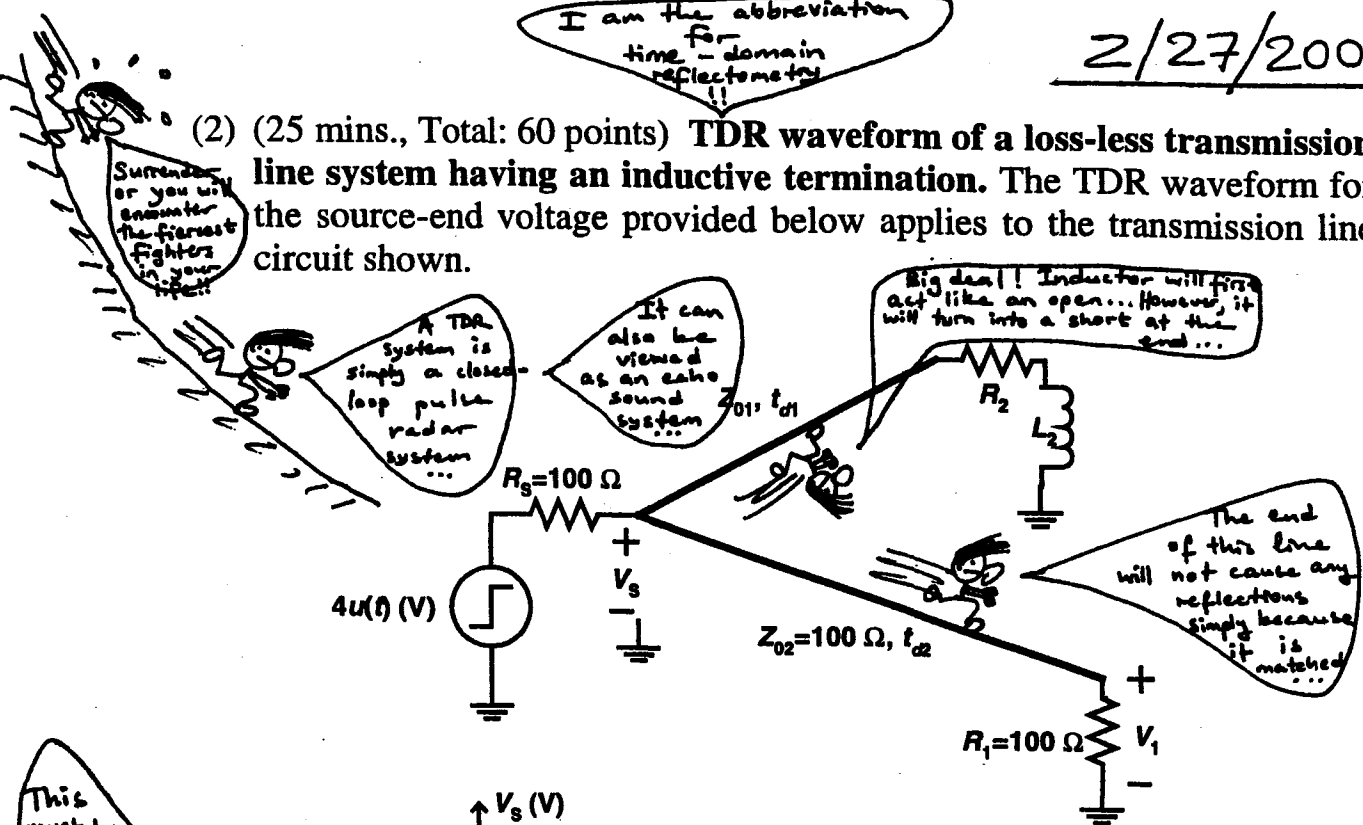
I am glad I had to stop after 2ns! Raaaaah!!

Inan trains his students to become fearless fighters!!

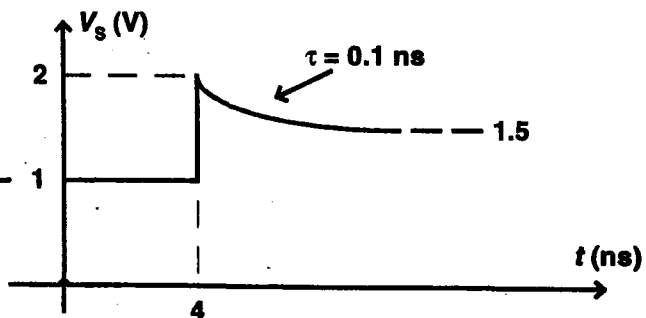
2/27/2004

I am the abbreviation for time-domain reflectometry !!

(2) (25 mins., Total: 60 points) TDR waveform of a loss-less transmission line system having an inductive termination. The TDR waveform for the source-end voltage provided below applies to the transmission line circuit shown.



This must be the value of the incident voltage wave...



This must be the value of 2t_d1...

(a) (40 points) Use the TDR waveform provided to calculate the values of the circuit parameters Z_{01} , t_{d1} , R_2 and L_2 .

$$V_s(t=0^+) = V_1 = \frac{100\Omega! \cdot 4V!}{R_s + (Z_{01} \parallel Z_{02})} = V_0 = 1V$$

$$\therefore Z_{01} \parallel Z_{02} = \frac{100}{3} \Omega \rightarrow \therefore Z_{01} = 50 \Omega$$

$$2t_{d1} = 4 ns \rightarrow \therefore t_{d1} = 2 ns$$

Testing the echo of my voice...



Two circuit parameters are captured & identified... The other two parameters are still at large...

Chaaaaarge !!

Time constant is L_2/R_{th} where R_{th} is R_2 in series with Z_{01} ...

2/27/2004

The time constant is given by

$$\tau = \frac{L_2}{R_2 + Z_{01}} = \frac{L_2}{R_2 + 50} = 0.1 \text{ ns}$$

From the TDR waveform!

When the circuit reaches steady state, we have

$$\begin{aligned} V_s(t \rightarrow \infty) &= V_1^+ + V_1^-(t \rightarrow \infty) \\ &= V_1^+ + \Gamma_2(t \rightarrow \infty) V_1^+ \\ &= V_1^+ + \frac{R_2 - Z_{01}}{R_2 + Z_{01}} V_1^+ \\ &= V_1^+ \left[1 + \frac{R_2 - Z_{01}}{R_2 + Z_{01}} \right] = (1) \left[1 + \frac{R_2 - 50}{R_2 + 50} \right] = 1.5V \end{aligned}$$

At steady state, L_2 behaves like a short...
 $\Gamma_2 = \frac{R_2 - Z_{01}}{R_2 + Z_{01}}$
 ...

From the TDR waveform!

Solving, $R_2 = 150 \Omega$. Substituting the value of R_2 into the time constant equation yields

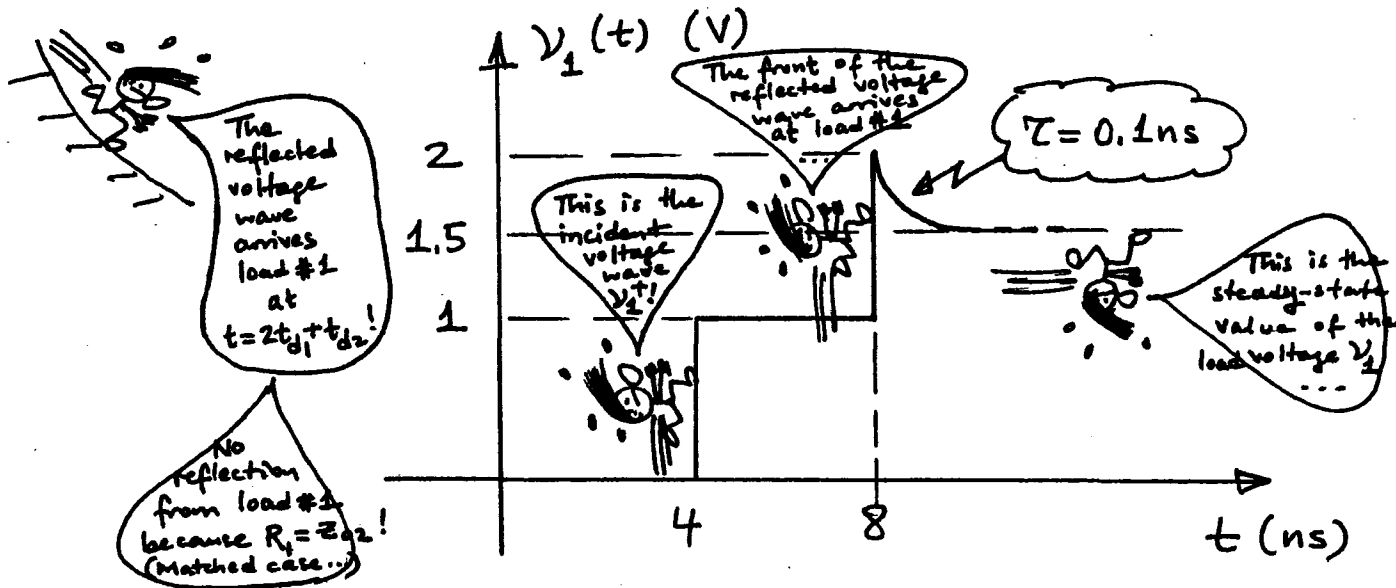
$$\frac{L_2}{150 + 50} = 0.1 \text{ ns} \rightarrow L_2 = 20 \text{ nH}$$

The identification of all of the four circuit parameters is accomplished...
 However, Inan's students don't rest until their mission is fully complete!
 Next problem: Attaaach!!

2/27/2004

Mission Impossible is not an acceptable cliché for Inan's students !!

(b) (20 points) Assuming $t_{d2}=4$ ns, sketch the voltage $V_1(t)$ across the 100Ω termination at the end of line # 2. Present all the relevant values on your sketch.



Now I can take the rest of the day off !!

The mission is complete! As always, Inan's students prevailed !!

