Homework Problem Set #2

(Due date: 2011/03/14)

This problem set covers materials of Lesson 2–3. The full score is 50 points.

1) (10%) Use the bounce diagram shown in Fig. 3-4a of the lecture notes to plot the temporal voltage waveform at $z = \frac{l}{2}$, i.e., $v(l/2, t)$. Compare it with that of Fig. 3-4b or Fig. 3-4c. What have you found?

2) (20%) Write a computer program to automatically plot $v(z_a, t)$, $0 \le z_a \le l$ for a system shown in Fig. 3-1 of the lecture notes. Verify your program by plotting: (a) Fig. 3-4c of the lecture notes, and (b) the result of Problem 1.

(*Hint*: Use the normalized quantities $\frac{v(z_a,t)}{Z_0}$, $\frac{z_a}{l}$, $\frac{t}{t_d}$ to simplify the programming.)

3) Consider the distributed circuit model of a lossless transmission line shown in Fig. 1. Assume the line is initially at rest, i.e. $v(z,0^-) = 0$ (zero voltage for any node N_i at $t = 0^-$), $i(z,0^-) = 0$ (zero current for any branch at $t = 0^-$).

3a) (5%) What is the voltage of node N_1 at $t = 0^+$, i.e. $v(0,0^+)$? What is the current along L_1 at $t = 0^+$, i.e. $i(0,0^+)$? Justify your answers. (*Hint*: Capacitor current: $i = C \cdot \frac{d}{dt} v$, inductor voltage: $v = L \cdot \frac{d}{dt} i$.)

3b) (5%) What is the current along C_1 at $t = 0^+$? What is the voltage of node N_2 at $t = 0^+$, i.e. $v(\Delta z,0^+)$? (*Hint*: Borrow the result of Problem 3a.)

3c) (10%) Describe how do node voltages at N_1, N_2, …, and branch currents along inductors L_1, L_2, … change with time ($t > 0^+$)? Justify the "wave" behavior accordingly.

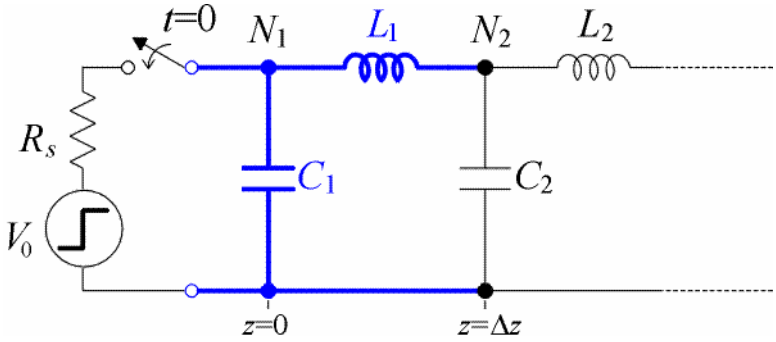

Fig. 1. Circuit model of transmission line.