2012 Fall Electromagnetics II – Quiz I

Date: 22/10/2012

The quiz time is 2 hours. There are six questions in this quiz, each scores 20 points. The fifth highest scores of the six questions will be your total score.

Student ID ________________ Name ____________________

Problem 1

In the system shown in **Fig. 1**, assume that Vg is a constant voltage source of 80 V and the switch S is closed at t = 0. Find and sketch: (a) the line voltage versus z for t = 0.2 μs; and (b) the line current versus z for t = 0.4 μs; (c) the line voltage versus t for z = 30 m; and (d) the line current versus t for z = -40 m. (20%)

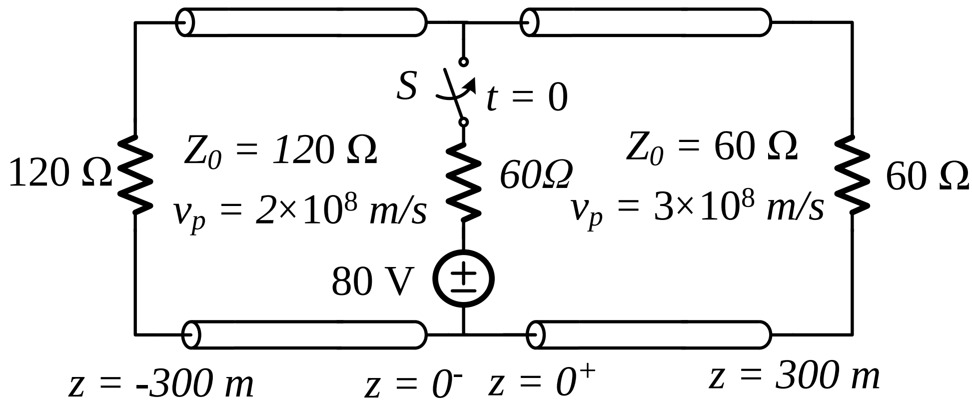

Fig. 1

Problem 2

In the system shown in **Fig. 2**: (a) find the output voltage Vo across the 150 Ω resistor for Vg(t) = δ(t); and (b) find the amplitude of Vo(t) versus ω for Vg(t) = cosωt. (20%)

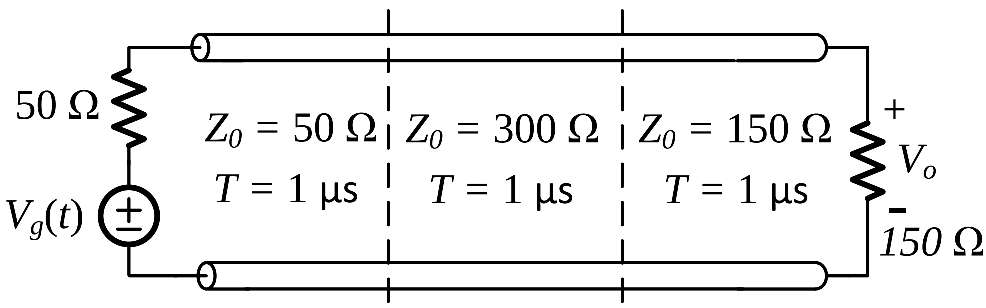

Fig. 2

Problem 3

In the system shown in **Fig.3**, the switch is closed at t = 0. Besides, there is no initial charge in the transmission line. (a) Obtain the differential equation for $V^{-}(l,t)$. (b) Find the value of $V^{-}(l,T)$. (c)Find the solution for $V^{-}(l,t)$. (20%)

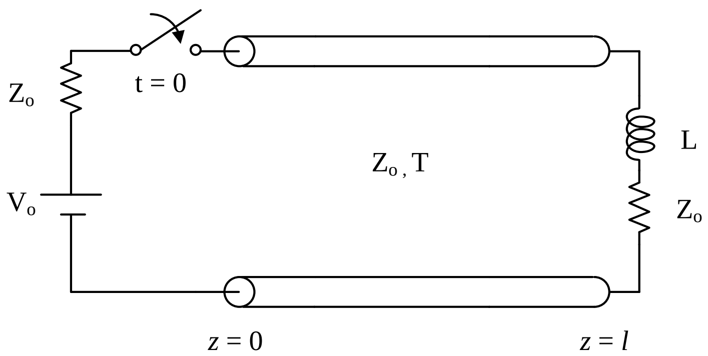

Fig.3

Problem 4

In the system shown below, the transmission line is charged to *Vo*, and keeps at steady-state at *Vo* and no current in the inductor. The switch is closed at t = 0. (a) For **Fig. 4(a)**, which wave will originate at t = 0, $z = l$, V^{+} or V^{-}. (b) Obtain the differential equation for that wave in problem (a). (c) For **Fig. 4(b)**, which wave will originate at t = 0, z = 0, V^{+} or V^{-} (d) Obtain the differential equation for that wave in problem (d) [You don't have to solve the differential equation] (20%)

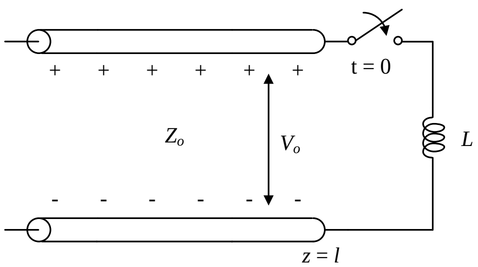

Fig. 4(a)

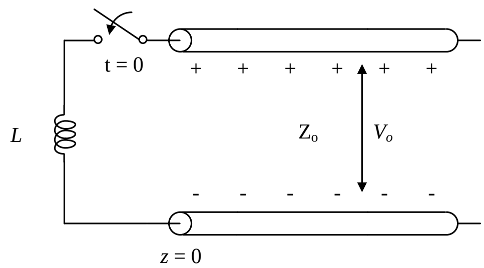

Fig. 4(b)

Problem 5

For the system of **Fig. 5**, the switch is closed at t=0. Assume $V_g(t)$ to be a direct voltage of 100 V. Use the load-line technique to obtain and plot line voltage and line current versus t (up to t=5.25μs) at z = 0 and z = l. Also obtain the steady-state values of line voltage and current from the load-line construction. (20 %)

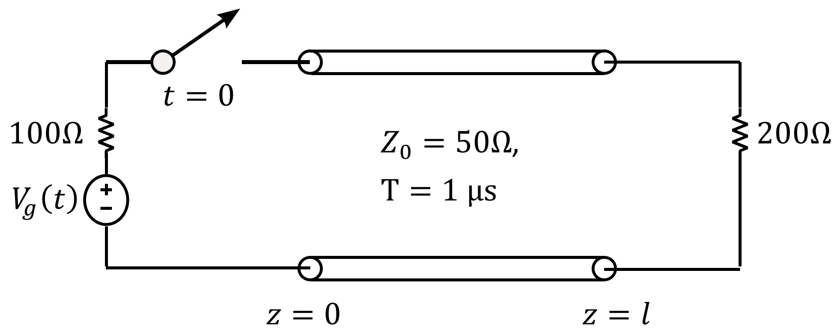

Fig. 5

Problem 6

(a) It is known that if two lines which length are both *l* are parallel and adjacent, there is crosstalk between two lines. That is, if a signal propagates on a primary line, another signal will be induced and propagate on the other line (called second line). Assume that the effect of the second line to the primary line is neglected and both lines are terminated by impedances equal to the characteristic impedance of two lines. The voltage signal on the second line propagating to the positive direction can be express as :

$$V_2^+(z,t) = zK_f V'_1\left(t - \frac{z}{v_p}\right) , \tag{1}$$

where $K_f = \frac{1}{2}(C_m Z_0 - \frac{L_m}{Z_0})$ is called the forward-crosstalk coefficient and $V_1\left(t - \frac{z}{v_p}\right)$ is the voltage signal on the primary line. C_m and L_m are coupling capacitance and coupling inductance, respectively. Prove the equation (1). (10%)

(b) As shown in **Fig. 6**, There is crosstalk between line 1 and line 2. The time consumption for signal transmitted from $z = 0$ to $z = l$ is T_0. The switch S is closed at $t = 0$ and opened again at $t = \delta t_0 \ll T_0$. Please sketch the waveforms of point A and point B from $t = 0$ to $t = 2T_0$ if the coupling between two lines is capacitive.(10 %)

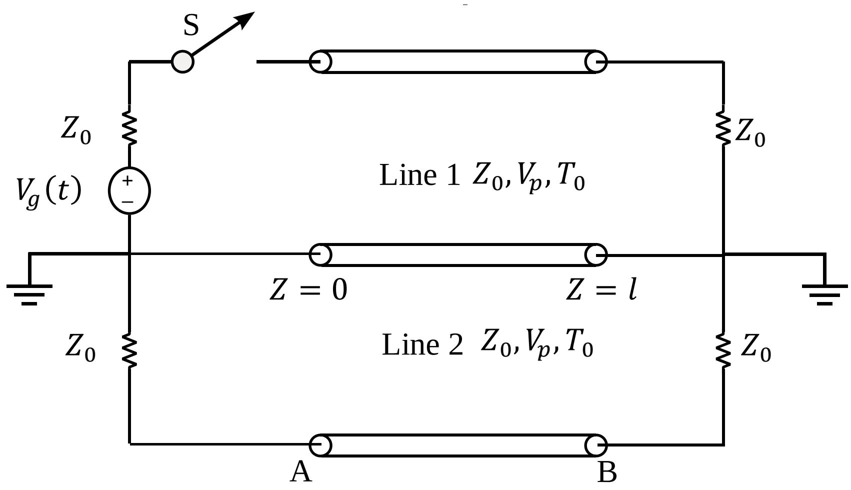

Fig. 6