

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Electrical Engineering and Computer Science

Problem Set No. 6  
Fall Term 2006

6.630 Electromagnetics

Issued: Week 7  
Due: Week 8

**Reading assignment:** Section 2.1, 2.2; J. A. Kong, “*Electromagnetic Wave Theory*”.

**Problem P6.1**

A break in a high-voltage DC power line occurs at  $z = 0$  at time  $t = 0$ , as shown in Fig.1. The line was carrying a DC voltage  $V_o$  and DC current  $I_o$  before the break occurred. Assume that the tree is non-conducting.

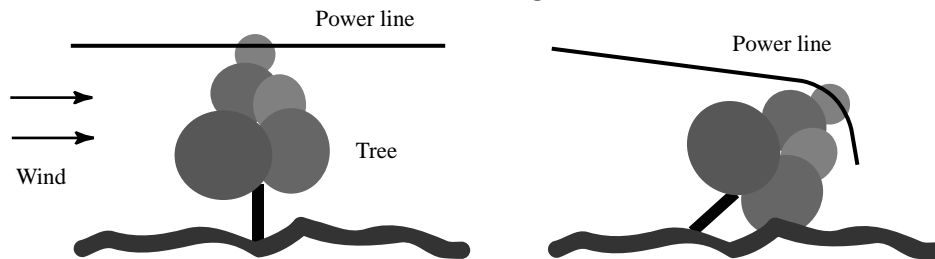


Fig. 1

- (a) Sketch  $I$  and  $V$  on the line at some time  $t$  after the break has occurred, but before any reflections from the source and load ends. The characteristic impedance of the line is  $Z_0$ .
- (b) Consider a 600 kV line, carrying a power of  $10^3$  megawatts, with a characteristic impedance of  $500 \Omega$  (two-wire line). What is the peak voltage on the line after the break occurs?

**Problem P6.2**

A very long transmission line with characteristic impedance  $Z_0$  and wave velocity  $v = c$  has a shunt resistor of unknown value  $R_L$  at an unknown location  $z = \ell$ . A measurement of the voltage at the input,  $V_o(t)$ , with a unit step generator applied to the line, yields the result shown in Fig. 2.

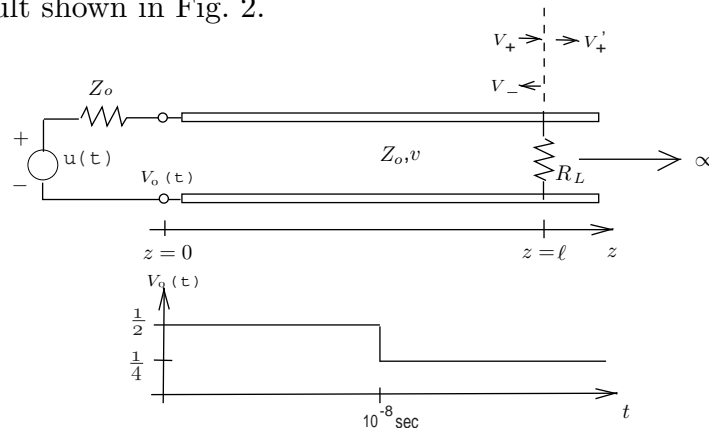


Fig. 2

- (a) What is  $\ell$ ?
- (b) What is  $R_L$ ?
- (c) Sketch the voltage and current distribution on the line at the time  $t = 1.5\ell/v$ .