Massachusetts Institute of Technology

Department of Electrical Engineering and Computer Science

6.061/6.690 Introduction to Power Systems

Problem Set 5 — Issued February 27, 2011

Due March 9, 2011

Reading: Chapters 4, 6 and 7 in the text

Problem 1: Shown in Figure 1 is a length of transmission line which is 100 km long. Actually, this is a coaxial cable with the following properties:

Rated Voltage	45 kV
Characteristic Impedance	$Z_s = 30\Omega$
Inductance	$C = 0.2\mu F/km$

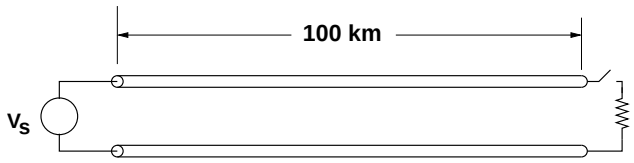

Figure 1: Transmission Line Example

1. What is the *inductance* per unit length of this line?
2. What is the speed of propagation of signals in the line?
3. The cable has 45 kV (DC) on it, supplied by the source on the left (V_s), when at $t = 0$ the switch is closed. The resistor has the same value as the charactaristic impedance of the line: $R = Z_0$. What is the voltage across the resistor as a function of time? Draw a dimensioned sketch.

Problem 2: The same transmission line is to be operated at 60 Hz and with a voltage, at the sending end, of 45 kV (RMS).

1. If the line is *open* at the receiving end, what is the magnitude of current drawn at the sending end? What is the magnitude of voltage at the receiving end?
2. The line is driving a resistive load of value $R_L = 60\Omega$. What are:
   (a) Receiving end voltage?
   (b) Sending end current?
   (c) Sending end power factor?
3. Demonstrate that the same *real* power leaves the source at the left as is absorbed by the load.

Problem 3: Do problem 6 from Chapter 6 of the text.

Problem 4: For 6.690: Do problem 7 from Chapter 6 of the text.

Problem 5: Do Problem 10 from Chapter 7 of the text.

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