6.061 / 6.690 Introduction to Electric Power Systems
Spring 2007

Massachusetts Institute of Technology

Department of Electrical Engineering and Computer Science

6.061/6.690 Introduction to Power Systems

Quiz 1

Closed Book: One Handwritten Crib Sheet Allowed

Please put your answers in the spaces provided on the quiz. You may, if you wish, turn in your work on additional sheets of paper. Hopefully you will get all the answers correct so I don't have to look at those sheets.

Problem 1: A three-phase voltage source is connected to two resistors as shown in Figure 1.The source is balanced, 120/208 V, RMS. The two resistors are 10 ohms each.

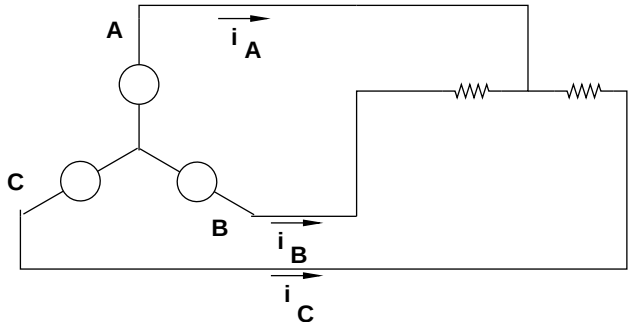

Figure 1: Source connected to load

1. Find the currents I_A, I_B and I_C and draw them on the template shown in Figure 2.
2. What are real and reactive power from each of the three voltage sources?

$(P + jQ)_A =$

$(P + jQ)_B =$

$(P + jQ)_C =$

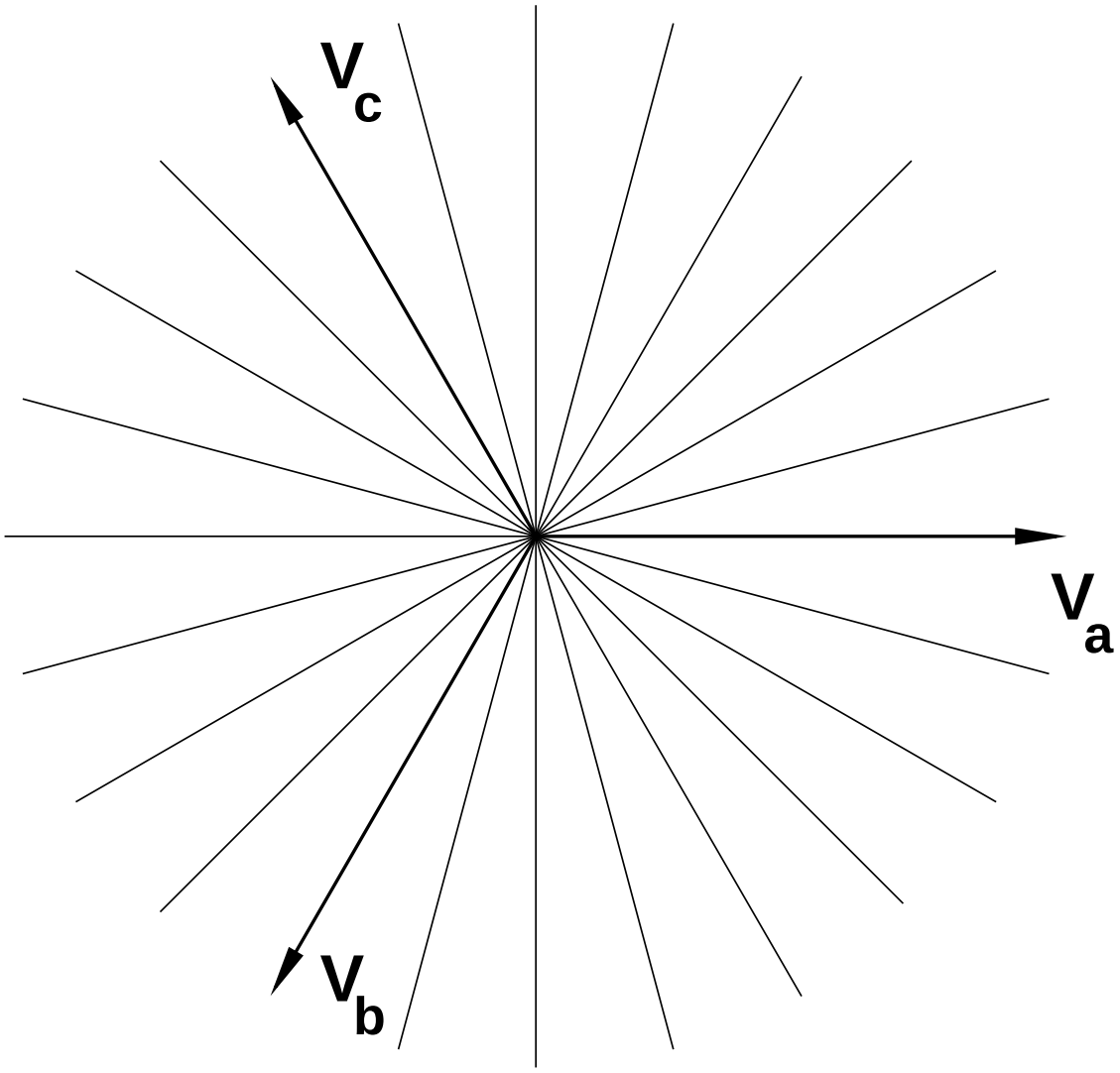

Figure 2: Template for your answer to Problem 1

Problem 2: A single phase AC source of 120V, RMS is connected to a 10Ω load resistor through an inductance as shown in Figure 3. A capacitor is connected in parallel to the resistor.

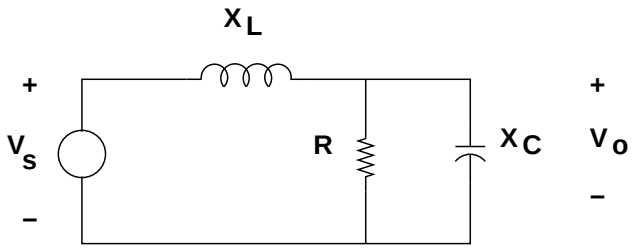

Figure 3: L-R-C Circuit

1. For what value of capacitive *reactance* is the voltage across the resistance equal to the source voltage?

2. For that value of capacitance, calculate:
   (a) Reactive power absorbed by the inductance,

   (b) Reactive power delivered by the capacitance,

   (c) Real and reactive power delivered by the voltage source

Problem 3 A transmission line problem is shown in Figure 4. The line is quite long: 1,500 km. At it's far end, it is shorted. At the near end the line is terminated in it's characteristic impedance of $Z_0 = 100\Omega$ and a current source of 10,000 A that has been on for a long time. At $t = 0$ the current source is suddenly turned off. On the template shown in Figure 5, plot:

1. Voltage and current along the line at $t = 3mS$,
2. Voltage and current along the line at $t = 8mS$,
3. Voltage at the near end (across the terminating resistance) as a function of time.

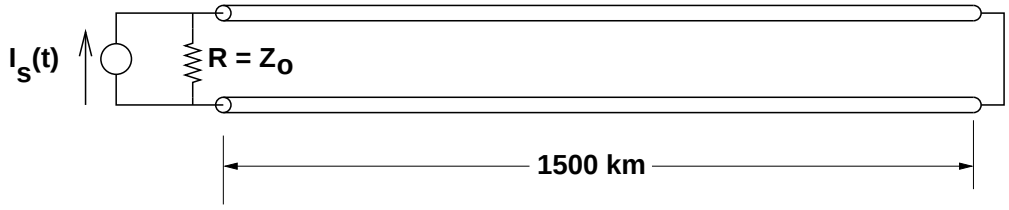

Figure 4: Transmission Line

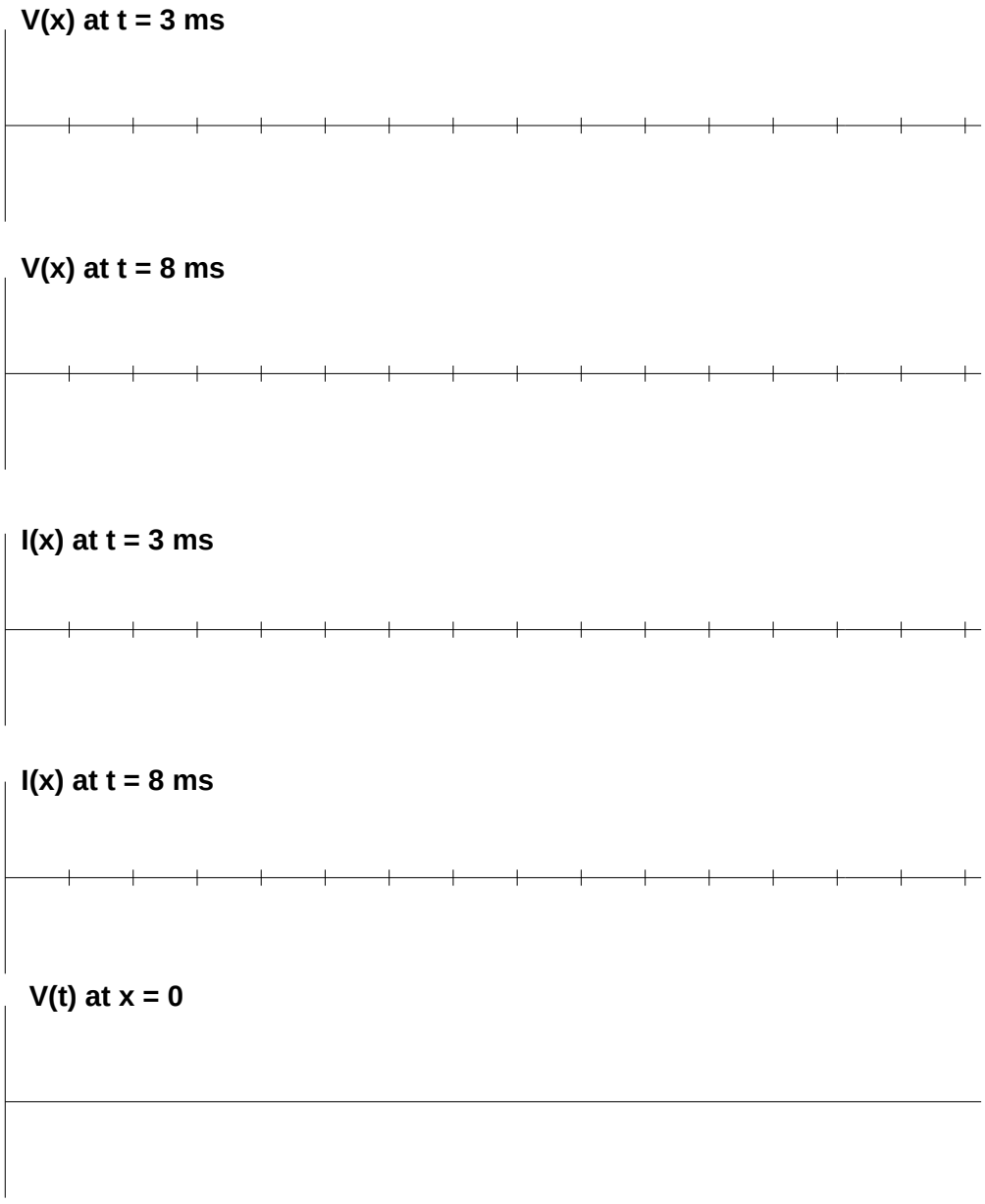

Figure 5: Transmission Line Answers