Georgia Institute of Technology
School of Electrical and Computer Engineering

EE4321 **Power System Engineering** **Spring 2009**

Homework Assignment #2
Due January 27, 2009

Problem P1: A three-phase transmission line connects two electrical power systems as in Figure P1a. The line configuration is shown in Figure P1b. Each phase conductor has the following parameters: r = 0.12 ohms/mile and GMR = 0.035 feet. The operating voltage of the line is 115kV line to line. The line length is 80 miles and the soil resistivity is 500 ohm-meters. Each of the power systems is represented as an equivalent source that is solidly grounded and with the following sequence impedances:

$Z_1 = Z_2 = j0.1\ pu$, $Z_0 = j0.06\ pu$

The voltage sources behind the equivalent impedances are in phase.

(a) Compute the fault currents for a single-phase to ground fault at the middle of the line using symmetrical components. Assume a 0.5 ohm fault impedance.
(b) Compute the fault currents for a single-phase to ground fault at the middle of the line using direct phase analysis. Assume a 0.5 ohm fault impedance.
(c) Compare the results from (a) and (b). State your own conclusions.

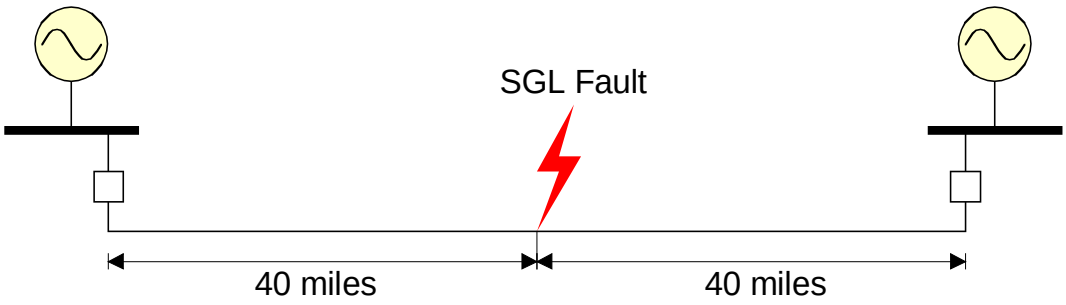

Figure P1a

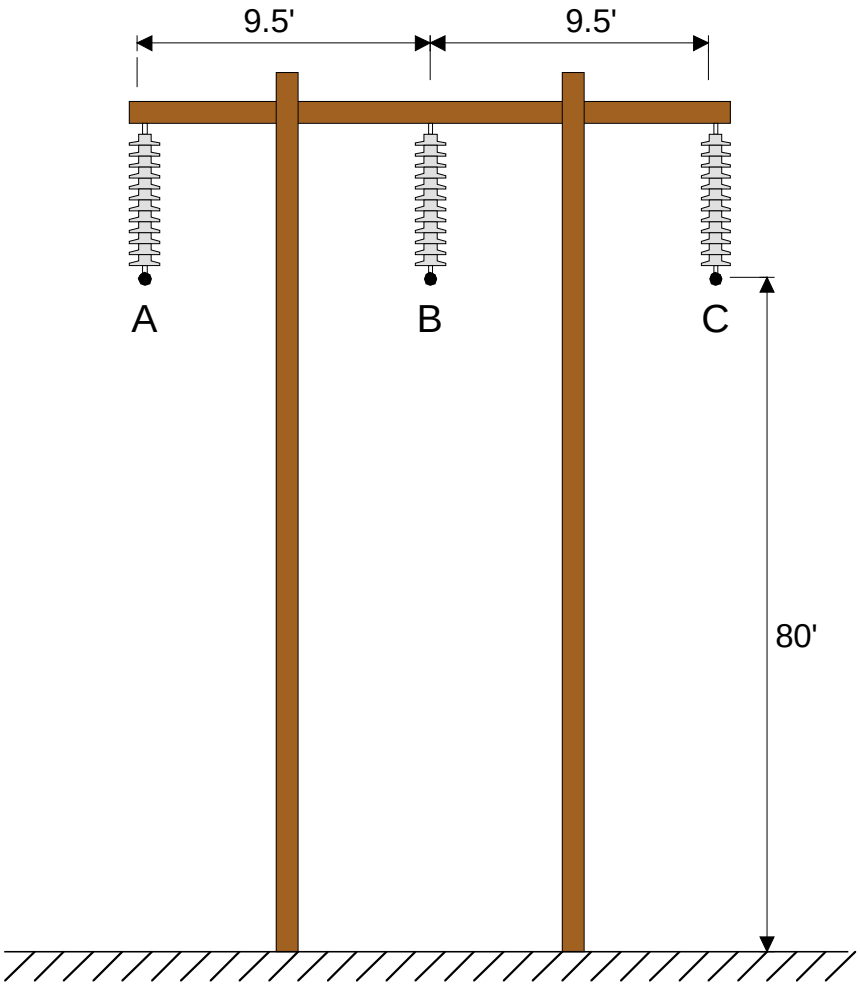

Figure P1b

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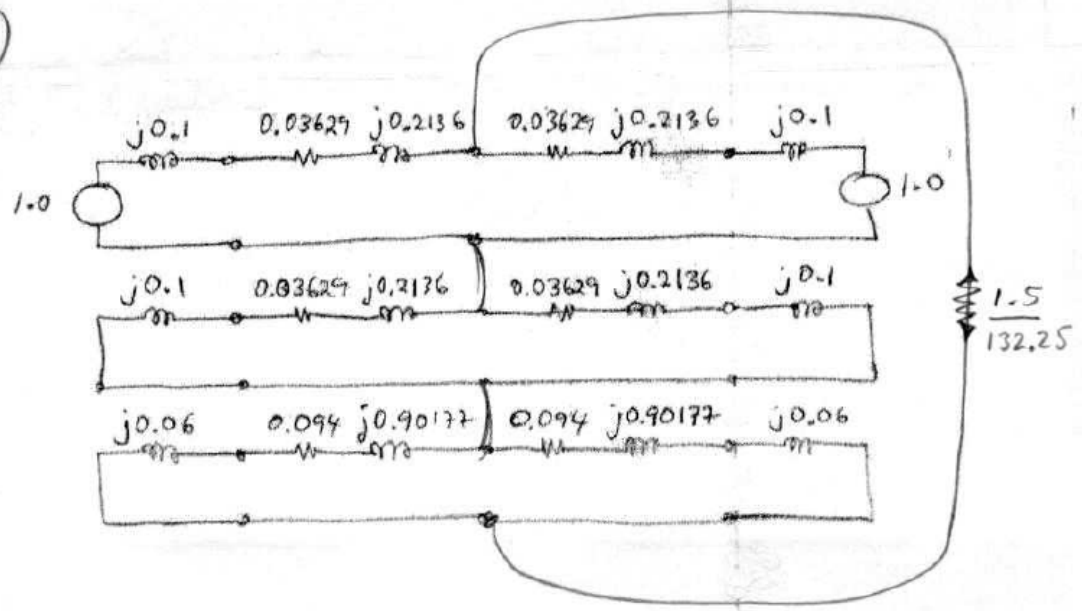
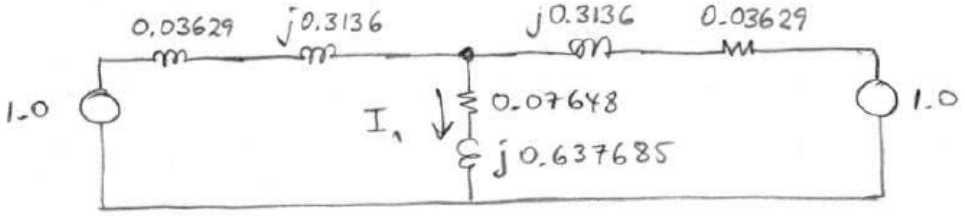
(a)



Reduced to



$$\tilde{I}_1 = \tilde{I}_2 = I_a = \frac{1.0}{0.094625 + j\,0.794485} = 1.24984\, e^{-j83.208^\circ}$$

$$\tilde{I}_a = 3.74952\, e^{-j83.208^\circ} \quad \text{or} \quad 1.8824\, e^{-j83.208^\circ}\ \text{kA}$$

(b) Computer generated result

$1.883\ \text{kA}\ e^{-j82.377^\circ}$

(c) Magnitude Error

0.03 %

Phase Error

0.831°