

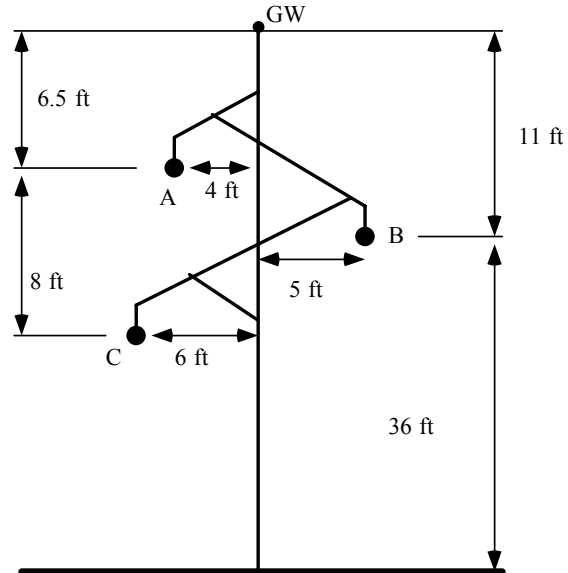
## ECE 523: Homework #5

### Due Session 33 (Nov 9 on campus, Nov. 23 for Engineering Outreach)

1. Compute the per mile positive and negative sequence impedance for the line configuration of figure below where the conductor is 336,400 CM, 26/7 Strand ACSR.

Conductor data from table:

$$\begin{aligned} \text{GMR} &:= 0.0244\text{ft} & \text{diameter} &:= 0.721\text{in} \\ \text{Rac} &:= 0.278 \frac{\text{ohm}}{\text{mi}} & & \text{at } 25\text{C and } 60\text{Hz} \end{aligned}$$



2. Compute the phase impedance matrix  $Z_{abc}$  for the line described in problem 1. Assume that the line is 50 miles long and is not transposed. Ignore the ground wire. Calculate the sequence impedance matrix.

3. Compute the total impedance matrix  $Z_{abc}$  for the lines of problem 2 with the following transposition arrangements. Calculate the sequence impedance matrix for each.

<i>Fraction</i>	<i>Configuration</i>
(a) $f_1 = 0.20$	a-b-c
$f_2 = 0.80$	b-c-a
$f_3 = 0.00$	c-a-b
(b) $f_1 = 0.25$	a-b-c
$f_2 = 0.35$	b-c-a
$f_3 = 0.40$	b-a-c
(c) $f_1 = 0.30$	a-b-c
$f_2 = 0.60$	c-a-b
$f_3 = 0.10$	c-b-a
(d) $f_1 = 1/3$	a-b-c
$f_2 = 1/3$	c-a-b
$f_3 = 1/3$	b-c-a

4 Consider the line configuration shown in Figure 2. Instead of using a single conductor of 336,400 CM ACSR in each phase, with current carrying capacity of 530 amperes, suppose that each phase consists of a two-conductor bundle of two 3/0 ACSR conductors with capacity of 300 amperes/conductor. Let the two conductors of each bundle be separated by 1.0ft vertically.

(a) Compute the phase impedance matrix  $Z_{abc}$  for the bundled conductor configuration and compare with the previous solution (problem 2).

$$R_{ac3} := 0.560 \frac{\text{ohm}}{\text{mi}} \quad \text{from table B.8 at 25C and 60Hz}$$

$$GMR3 := 0.006\text{ft} \quad \text{diameter3} := 0.502\text{in}$$

(b) Calculate geometric mean radius of the bundle and use the 3x3 matrix method. This is an approximation of the 6x6 matrix approach. Compare the results to part (a).

(c) Compute the sequence impedance matrix for part (a) and compare to problem 2.

5. Consider an untransposed line described in problem 2. Let the ground wire be 1/0 ACSR and recalculate the phase impedance matrix  $Z_{abc}$ , the sequence impedance matrix  $Z_{012}$ , and the unbalance factors. Compare with previous results from problem 2 for the same line without the ground wire.

- Ground wire data:

$$R_{ac\_gw} := 0.888 \frac{\text{ohm}}{\text{mi}} \quad \text{at 25C and 60Hz}$$

$$GMR\_gw := .00446\text{ft} \quad \text{diameter\_gw} := .398\text{in}$$

- Phase conductors same as in problem 2.

6. Repeat problem 5 with the transposition of problem 3, part (d).