ECE 523: Homework #5

Due Session 27 (November 28)

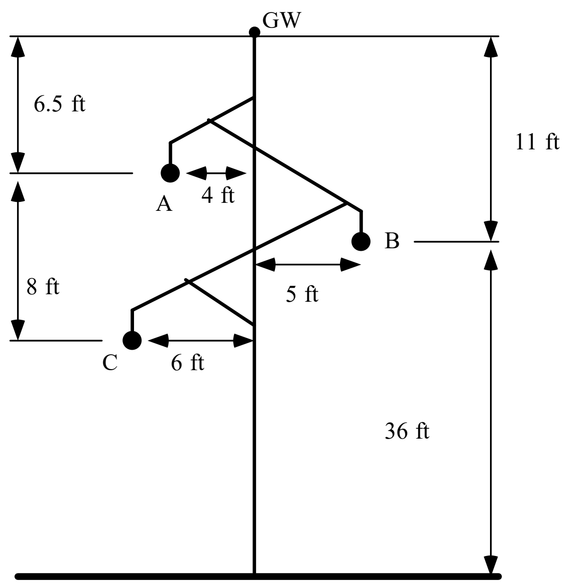
1. Compute the per mile positive and negative sequence impedance for the line configuration of figure below where the conductor is 336,400 CM, 26/7 Strand ACSR.
Ignore the ground wire for problems 1-4.

Conductor data from table:

$GMR := 0.0244ft$ diameter $:= 0.721in$

$Rac := 0.278 \frac{ohm}{mi}$ at 25C and 60Hz

Assume each conductor is 10 feet lower at mid span than at tower.



2. Compute the phase impedance matrix Z_{abc} for the line described in problem 1. Assume that the line is 70 miles long and is not transposed. Ignore the ground wire. Calculate the sequence impedance matrix.

3. Compute the total impedance matrix Zabc for the lines of problem 2 with the following transposition arrangements. Calculate the sequence impedance matrix for each.

	Fraction	*Configuration*
(a)	f1 = 0.20	a-b-c
	f2 = 0.80	b-c-a
	f3 = 0.00	c-a-b
(b)	f1 = 0.30	a-b-c
	f2 = 0.60	c-a-b
	f3 = 0.10	c-b-a
(c)	f1 = 1/3	a-b-c
	f2 = 1/3	c-a-b
	f3 = 1/3	b-c-a

4 Consider the line configuration shown in the figure for problem 1. 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 seperated by 1.0ft vertically. Assume same sag as for problem 1.

(a) Compute the 6x6 phase impedance matrix Zabc for the bundled conductor configuration and reduce it to the 3x3 equivalent and compare with the previous solution (problem 2).

$$\text{Rac4} := 0.560\,\frac{\text{ohm}}{\text{mi}}$$ from table

$\text{GMR4} := 0060\text{ft}$ $\quad$ $\text{diameter4} := 0.502\text{in}$

(b) Calculate geometric mean radius of the bundle and use the 3x3 matrix method. The 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 with a ground wire added. Let the ground wire be 1/0 ACSR and recalculate the phase impedance matrix Zabc, the sequence impedance matrix Z012, and the unbalance factors. Compare with previous results from problem 2 for the same line without the ground wire. Assume phase conductors have same sag as problem 1, and that the groundwire is 7 feet lower at mid span than at the tower.

- Ground wire data:

  $$\text{Rac\_gw} := 0.888\,\frac{\text{ohm}}{\text{mi}}$$ at 25C and 60Hz

  $\text{GMR\_gw} := 0.01113\text{ft}$ $\quad$ $\text{diameter\_gw} := .398\text{in}$

- Phase conductors same as in problem 2.

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

7. Repeat problems 1-2 calculating capacitance.