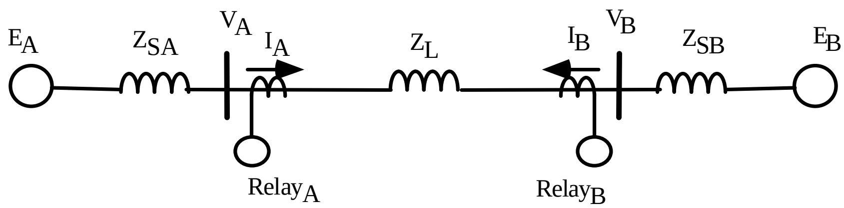
ECE 525: Homework #1

Due Session 6 (Sept. 6)

1. Given the power system below:



Where the following are given as CT and VT secondary quantities::

$E_{SA} := 70V \cdot e^{j \cdot 0deg}$ $\quad E_{SB} := 70V \cdot e^{-j \cdot 30deg}$

$Z_{SA1} := 1.5ohm \cdot e^{j \cdot 87deg}$ $\quad Z_{SA2} := Z_{SA1}$ $\quad Z_{SA0} := 5ohm \cdot e^{j \cdot 87deg}$

$Z_{SB1} := 0.8ohm \cdot e^{j \cdot 83deg}$ $\quad Z_{SB2} := Z_{SB1}$ $\quad Z_{SB0} := 2.5ohm \cdot e^{j \cdot 83deg}$

$Z_{L1} := 5ohm \cdot e^{j \cdot 82deg}$ $\quad Z_{L0} := 18ohm \cdot e^{j \cdot 82deg}$

The current trransformer ratios are: $CTR := \frac{1200}{5}$

The voltage transformer ratios are: $VTR := \frac{132.8kV}{70V}$ Line-to-neutral

A. Calculate the source voltages, line and source impedances and line current referred to primary values based on the information given above. Also find the line currents in secondary Amps accounting for CT polarity.

B. Repeat part A in per unit

C. Calculate real and reactive power flow at Bus A and Bus B based on the CT polarity using primary values

D. For the conditions of part A, calculate the effective imedance measured by Relay A and Relay B in terms of secondary values.

E. Suppose a 3 phase fault occurs 30% of the way from Bus A to Bus B, do the following:
  (1) Calculate the total fault current and the current seen at Relay A and Relay B in primary and secondary quantities.
  (2) Compare the fault currents to the load currents calculated earlier with load currents
  (3) Calculate the effective impedances distance elements at Relay A and Relay B would calculate in secondary and primary ohms.
  (4) What Iop and Irt be for a differential element (assume a charging current of 100 A capacitive divided equally between each end), for the fault and load flow of part A.

2. Sketch the winding connections for a Yg-Δ transformer following the ANSI/IEEE connection standard if (a) the Y-connected winding is the HV winding and (b) if the Δ-connected winding is the HV winding. The diagram below gives an example of what we're looking for as an answer.