ECE 3600 homework DD Go to ME Design day in the Union, Thur, 4/18, Due Sat, 4/20

Write 2 to 4 paragraphs (1/3 - 1 page) about what you see there, especially mention the power and energy related items.

Name: _____ ECE 3600 homework LF1 Due: Sat, 4/13/24 axt

1. A transmission line suffers a single-line to ground fault on phase-A.

   The fault currents are: $\mathbf{I_A} := 6 \cdot pu \quad \underline{/0^o} \qquad \mathbf{I_B} := 0 \qquad \mathbf{I_C} := 0$

   Calculate the symmetrical components of the fault current, $\mathbf{I}_{A1}$, $\mathbf{I}_{A2}$ and $\mathbf{I}_{A0}$.

2. A transmission line suffers a line-line fault between phase-A and phase-B.

   The fault currents are: $\mathbf{I_A} = 0$ and $\mathbf{I_B} = -\mathbf{I_C} = 4 \underline{/0^o}$ pu .

   Calculate the symmetrical components, $\mathbf{I}_{A1}$, $\mathbf{I}_{A2}$ and $\mathbf{I}_{A0}$.

3. A transmission line suffers an unknown fault.

   The symmetrical components of $\mathbf{I_A}$ are: $\mathbf{I}_{A1} := -2 + 3 \cdot j \quad pu \qquad \mathbf{I}_{A2} := 2 - 3 \cdot j \quad pu \qquad \mathbf{I}_{A0} := 0$

   a) Find the fault currents, $\mathbf{I_A}$, $\mathbf{I_B}$ and $\mathbf{I_C}$.

   b) What kind of fault is it?

4. A transmission line suffers an unknown fault.

   The symmetrical components of $\mathbf{I_A}$ are: $\mathbf{I}_{A1} := 1 + \sqrt{3}\cdot j \;\; pu$ $\mathbf{I}_{A2} := 1 - \sqrt{3}\cdot j \;\; pu$ $\mathbf{I}_{A0} := 4$

   a) Find the fault currents, $\mathbf{I_A}$, $\mathbf{I_B}$ and $\mathbf{I_C}$.

   b) What kind of fault is it?

5. If a short occurs between lines b and c of a 3-phase transmission line, the zero-sequence circuit can be ignored in the analysis, why?

6. At point X in the power system, there is an open-circuit fault. Phase-A is open. The voltage across the open-circuit is: $\mathbf{V_A} = 0.9 \angle 0^o$ pu. Since the other two lines are intact, the other two voltages across point X are $\mathbf{V_B} = \mathbf{V_C} = 0$.

   a) Calculate the sequence components $\mathbf{V}_{A1}$, $\mathbf{V}_{A2}$ and $\mathbf{V}_{A0}$ at the fault point.

   Note: this is the same as the calculations of the short-circuit sequence currents, only now the voltages are measured across the fault point and the "fault" currents are the line currents.

   b) Is there anything you can say about the symmetrical line current components, $\mathbf{I}_{A1}$, $\mathbf{I}_{A2}$ and $\mathbf{I}_{A0}$?

Answers

1. all $2\cdot pu$ 2. $2.309\cdot j\cdot pu$ $-2.309\cdot j\cdot pu$ 0 OR $\begin{bmatrix} \mathbf{I}_{A0} \\ \mathbf{I}_{A1} \\ \mathbf{I}_{A2} \end{bmatrix} = \begin{pmatrix} 0 \\ 2.309\cdot j \\ -2.309\cdot j \end{pmatrix}\cdot pu$

3. a) 0 $5.196 + 3.464\cdot j$ $-5.196 - 3.464\cdot j$ b) Since $\mathbf{I_B} = -\mathbf{I_C}$, must be a line-to-line fault between phase-A and phase-B

4. a) 6 6 0 b) Since $\mathbf{I_A} = \mathbf{I_B}$, and $\mathbf{I_C} = 0$, must be a double line-to-ground fault with phase-A and phase-B grounded

5. No connection to ground means no zero-sequence current can flow.
   Since there is no zero-sequence voltage source ($\mathbf{E_{A0}} = 0$), no current means no voltage as well.

6. a) all $0.3\cdot pu$ b) $\mathbf{I_A} = \mathbf{I}_{A1} + \mathbf{I}_{A2} + \mathbf{I}_{A0} = 0$