Examples

Example 1: Compute sequence components of the following balanced a-b-c sequence line-to-neutral voltages.

$$\underline{V}_{abc} = \begin{bmatrix} V_{an} \\ V_{bn} \\ V_{cn} \end{bmatrix} = \begin{bmatrix} 277\angle 0° \\ 277\angle -120° \\ 277\angle 120° \end{bmatrix}$$

Solution:

$$\underline{V}_S = \underline{A}^{-1}\underline{V}_{abc} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & \alpha & \alpha^2 \\ 1 & \alpha^2 & \alpha \end{bmatrix}\begin{bmatrix} V_{an} \\ V_{bn} \\ V_{cn} \end{bmatrix}$$

$$= \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & \alpha & \alpha^2 \\ 1 & \alpha^2 & \alpha \end{bmatrix}\begin{bmatrix} 277\angle 0° \\ 277\angle -120° \\ 277\angle 120° \end{bmatrix}$$

$$= \frac{1}{3}\begin{bmatrix} 277\angle 0° + 277\angle -120° + 277\angle 120° \\ 277\angle 0° + \alpha 277\angle -120° + \alpha^2 277\angle 120° \\ 277\angle 0° + \alpha^2 277\angle -120° + \alpha 277\angle 120° \end{bmatrix}$$

$$= \frac{1}{3}\begin{bmatrix} 0 \\ 3\times 277\angle 0° \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 277\angle 0° \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ V_{an} \\ 0 \end{bmatrix}$$

Implication: the only sequence component in a set of 3-phase a-b-c balanced quantities is the positive sequence component.

Example 2: Compute the sequence components for a balanced Y-load that has phase b opened.

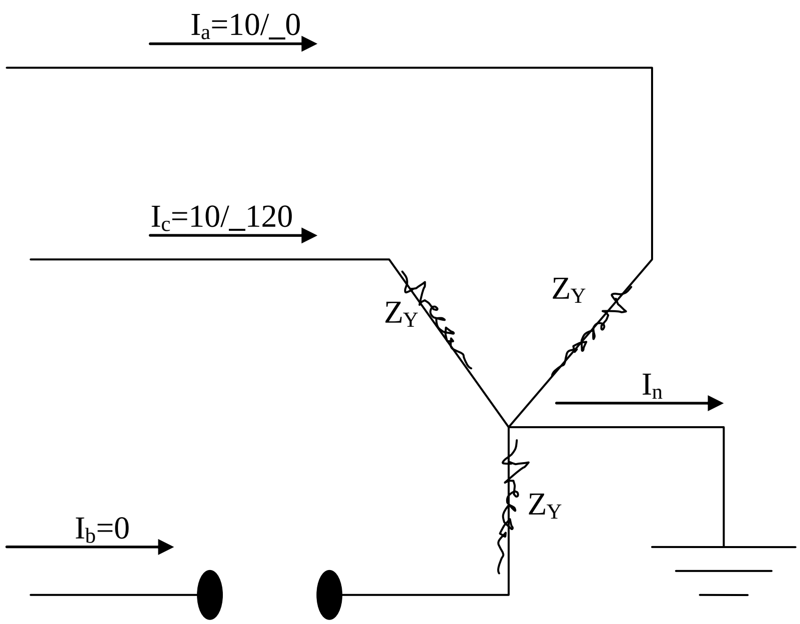

Fig. 1: Balanced Y load with open phase b

$$\underline{I}_S = \underline{A}^{-1}\underline{I}_{abc} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix}$$

$$= \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} 10\angle 0° \\ 0 \\ 10\angle 120° \end{bmatrix}$$

$$= \frac{1}{3}\begin{bmatrix} 10\angle 0° + 0 + 10\angle 120° \\ 10\angle 0° + a0 + a^2 10\angle 120° \\ 10\angle 0° + a^2 0 + a10\angle 120° \end{bmatrix} = \begin{bmatrix} 3.333\angle 60° \\ 6.667\angle 0° \\ 3.333\angle -60° \end{bmatrix}$$

Implication: Zero-sequence component will result from an unbalanced load if the a-b-c quantities do not sum to zero.

HW#3

1. As assigned at bottom of notes called "Fault analysis using Zbus".
2. As assigned at bottom of notes called "Fault analysis using Zbus".
3. A Y-connected load has balanced currents with a-c-b sequence given by

$$\underline{I}_{abc} = \begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix} = \begin{bmatrix} 10\angle 0^\circ \\ 10\angle +120^\circ \\ 10\angle -120^\circ \end{bmatrix}$$

   Calculate the sequence currents. How does your answer differ from the answer obtained in Example 1 in these notes?

4. A feeder provides service to a delta-connected load having the following phase currents:

$$I_{ab} = 208.3\angle -18.19^\circ$$

$$I_{bc} = 138.89\angle -151.788^\circ$$

$$I_{ca} = 131.94^\circ\angle 145.84$$

   a. For the phase currents:
      i. Are they balanced or unbalanced?
      ii. What is their sum?

iii. Obtain their sequence quantities.
iv. What is the 0-sequence quantity?

b. Obtain the line currents. For these currents:
   i. Are they balanced or unbalanced?
   ii. What is their sum?
   iii. Obtain their sequence quantities.
   iv. What is the 0-sequence quantity?

c. Use what you have learned in the parts (a) and (b) to answer the questions (ii, iv) from part (b) for the following a-b-c quantities:
   i. Unbalanced currents into a grounded-Y.
   ii. Unbalanced currents into an ungrounded-Y.
   iii. Unbalanced line-to-line voltages.