Problem Set #8 The symmetrical components of unsymmetrical phasors

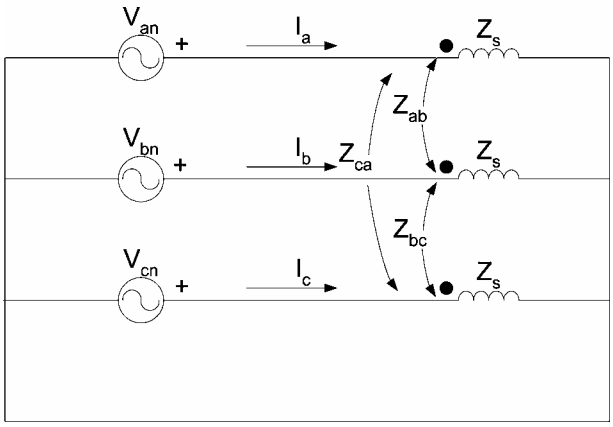
8-1 (Keyhani Lecture)
Given

$$Z_{abc} = \begin{bmatrix} Z & 0 & 0 \\ 0 & Z & 0 \\ 0 & 0 & Z \end{bmatrix}$$

Find Z_{012}.

8-2 (Keyhani Lecture)
Consider the circuit shown below. Suppose V_{an}=100∠0°, V_{bn}=50∠180°, V_{cn}=50∠180°, Z_s=8+j10, and Z_{ab}= Z_{bc}= Z_{ca}=j4.

a) Calculate I_a, I_b, and I_c without using symmetrical components.
b) Calculate I_a, I_b, and I_c using symmetrical components.



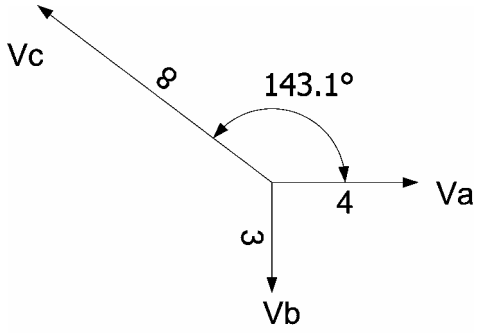
8-3 (Keyhani Lecture)
Frequently, T is defined as

$$\frac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix}$$

When this is the case, T is unitary.

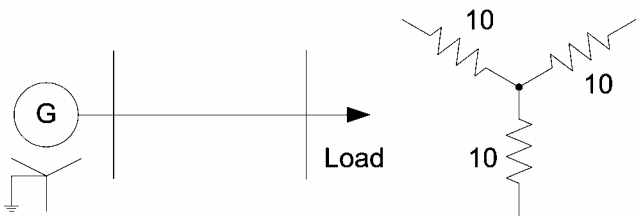
a) Prove it. A matrix is unitary when its inverse equals its transpose conjugate.
b) Defining T as in part a), prove that $S_{3\phi} = V_{abc}^T I_{abc}^* = V_{012}^T I_{012}^*$. This result is called the invariance of power condition and makes a strong case for the corresponding definition of T.

8-4 (Keyhani Lecture)
Three-phase system

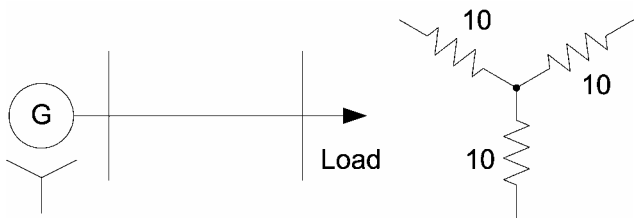


feeding a three-phase balanced load as shown:

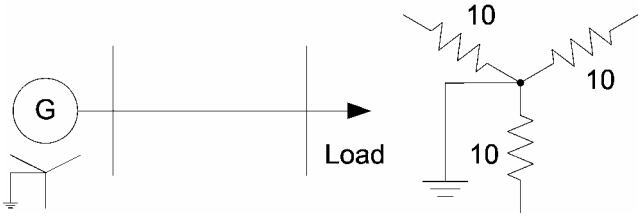
a)



b)



c)



Compute I_0, I_1, I_2, and I_a for part a, b, and c.