



IIT ROORKEE



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CERTIFICATION COURSE

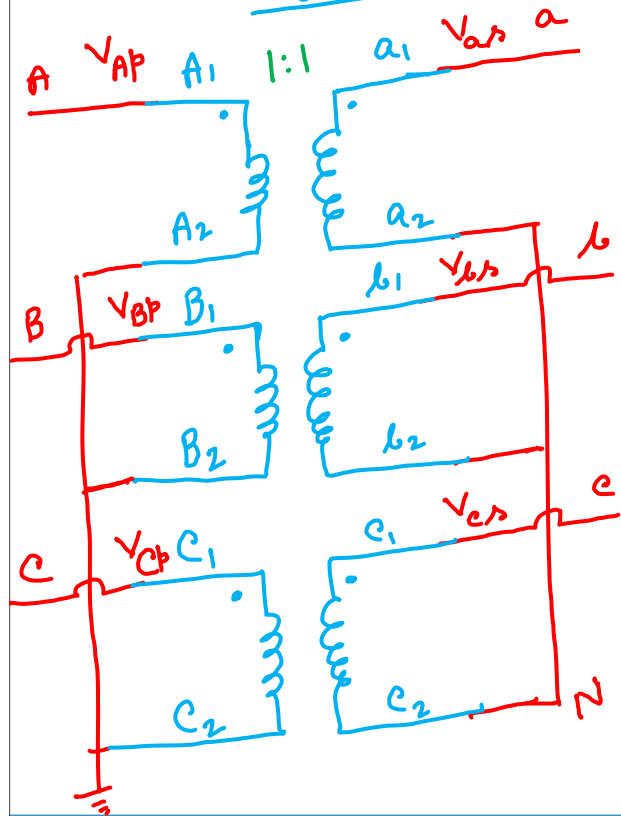
Computer aided power system analysis

Fault Analysis (Contd.)

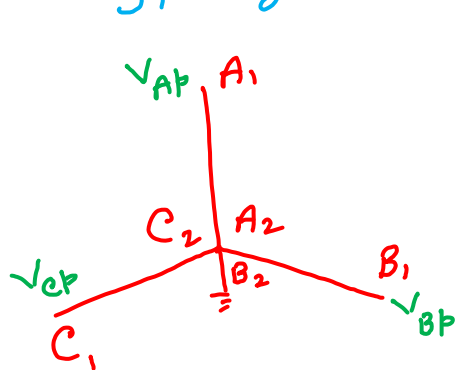
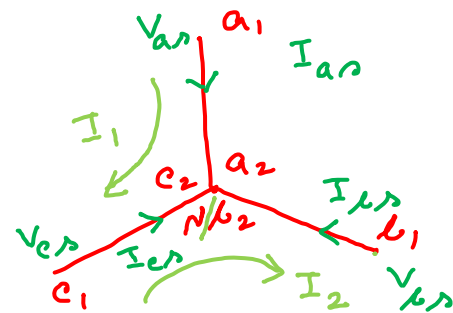
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Y- Δ Transformer



Star-grounded/star Transformer



$Z \rightarrow$ Transformer impedance

$Y = \frac{1}{Z} \rightarrow$ Transformer admittance.

KVL in loop $a_1 - c_1$

$$V_{as} - ZI_1 - V_{Ap} - Z(I_1 - I_2) + V_{Cp} - V_{cs} = 0$$



$$\Rightarrow ZI_1 + Z(I_1 - I_2) = V_{a\delta} - V_{Ap} + V_{c\delta} - V_{c\delta}$$

$$\Rightarrow 2ZI_1 - ZI_2 = V_{a\delta} - V_{Ap} + V_{c\delta} - V_{c\delta} \quad \text{-----} \textcircled{1}$$

KVL in the loop $c_1 - b_1$

$$V_{c\delta} - Z(I_2 - I_1) - V_{c\delta} - ZI_2 + V_{Bp} - V_{\mu\delta} = 0$$

$$\Rightarrow Z(I_2 - I_1) + ZI_2 = V_{c\delta} - V_{c\delta} + V_{Bp} - V_{\mu\delta}$$

$$\Rightarrow -ZI_1 + 2ZI_2 = V_{c\delta} - V_{c\delta} + V_{Bp} - V_{\mu\delta} \quad \text{-----} \textcircled{2}$$

$$\textcircled{2} \times 2 \Rightarrow -2ZI_1 + 4ZI_2 = 2(V_{c\delta} - V_{c\delta} + V_{Bp} - V_{\mu\delta}) \quad \text{--} \textcircled{3}$$

$$\textcircled{1} + \textcircled{3} \Rightarrow 3ZI_2 = \overset{\checkmark}{V_{a\delta}} - \overset{\checkmark}{V_{Ap}} + \overset{\checkmark}{V_{c\delta}} - \overset{\checkmark}{V_{c\delta}} + 2\overset{\checkmark}{V_{c\delta}} - 2\overset{\checkmark}{V_{c\delta}} + 2\overset{\checkmark}{V_{Bp}} - 2\overset{\checkmark}{V_{\mu\delta}}$$

$$\Rightarrow 3ZI_2 = -V_{Ap} + 2V_{Bp} - V_{c\delta} + V_{a\delta} - 2V_{\mu\delta} + V_{c\delta}$$



$$\Rightarrow I_2 = \frac{2}{3} (-V_{Ap} + 2V_{Bp} - V_{Cp} + V_{an} - 2V_{bn} + V_{cn}) \quad \dots\dots (4)$$

$$\text{By } (1) \times 2 \Rightarrow 4ZI_1 - 2ZI_2 = 2(V_{an} - V_{Ap} + V_{Cp} - V_{cn}) \quad \dots\dots (5)$$

$$\text{By } (5) + (2) \Rightarrow 3ZI_1 = \cancel{V_{cn}} - \cancel{V_{Cp}} + \cancel{V_{Bp}} - \cancel{V_{bn}} + 2V_{an} - 2\cancel{V_{Ap}} + 2\cancel{V_{Cp}} - 2\cancel{V_{cn}}$$

$$\Rightarrow 3ZI_1 = -2V_{Ap} + V_{Bp} + V_{Cp} + 2V_{an} - V_{bn} - V_{cn}$$

$$\Rightarrow I_1 = \frac{2}{3} (-2V_{Ap} + V_{Bp} + V_{Cp} + 2V_{an} - V_{bn} - V_{cn}) \quad \dots\dots (6)$$

$$\text{Now, } I_{an} = I_1; \quad I_{bn} = -I_2; \quad I_{cn} = I_2 - I_1$$

$$I_{bn} = \frac{2}{3} (V_{Ap} - 2V_{Bp} + V_{Cp} - V_{an} + 2V_{bn} - V_{cn}) \quad \dots\dots (7)$$



$$I_{cs} = I_2 - I_1 = \frac{2}{3} \left[-V_{Ap} + 2V_{Bp} - V_{Cp} + V_{as} - 2V_{bs} + V_{cs} \right. \\ \left. + 2V_{Ap} - V_{Bp} - V_{Cp} - 2V_{as} + V_{bs} + V_{cs} \right]$$

$$\Rightarrow I_{cs} = \frac{2}{3} \left[V_{Ap} + V_{Bp} - 2V_{Cp} - V_{as} - V_{bs} + 2V_{cs} \right] \dots \textcircled{8}$$

