Assignment 2.

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Date
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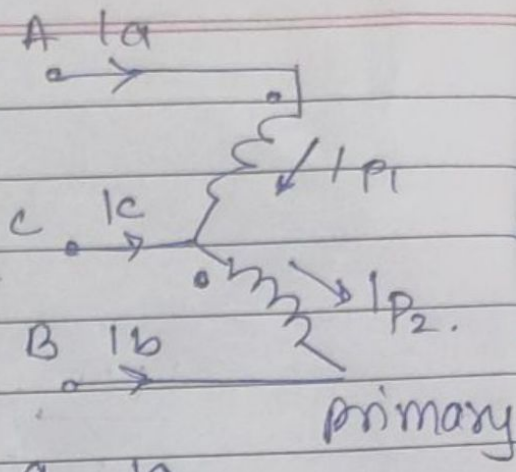
Q1. 3phase Y connected transformer 6600V(L-L) 50Hz supply voltage star connected 415V(L-L) load with $(8+6j)\Omega$/phase load. Find impedance.

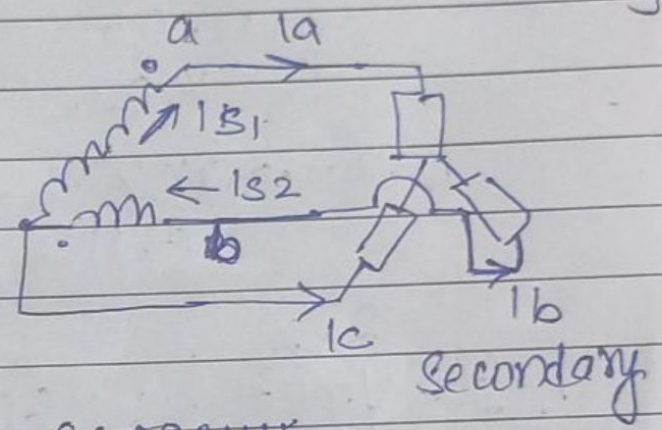


V_{AB} → reference.

$V_{AB} = 6600\angle 0$ V

$V_{BC} = 6600\angle -120$ V

$V_{CA} = 6600\angle 120$ V



$V_{ab} = 415\angle 0$ V

$V_{bc} = 415\angle -120$ V

$V_{ca} = 415\angle 120$ V

$6600 : 415$

$\Rightarrow 15.903 : 1$

$V_{an} = 415/\sqrt{3}\angle -30$ V

$V_{bn} = 415/\sqrt{3}\angle -150$ V

$V_{cn} = 415/\sqrt{3}\angle 90$ V

$I_a = \frac{V_{an}}{Z} = \frac{415/\sqrt{3}\angle -30}{8+6j}$

$= 23.96\angle -66.86$ A

$I_b = \frac{V_{bn}}{Z} = \frac{415/\sqrt{3}\angle -150}{8+6j}$

$= 23.96\angle 173.13$ A

(i) Phase currents in secondary of transformer

$I_{s_1} = I_a = 23.96 \angle -66.86$ A

$I_{s_2} = -I_b = 23.96 \angle 6.87$ A.

primary side currents in transformer.

$I_{p_1} = \frac{415}{6600} * (23.96 \angle -66.86)$

$I_{p_1} = 1.5 \angle -66.86$ A.

$I_{p_2} = \frac{415}{6600} * (23.96 \angle -6.87)$

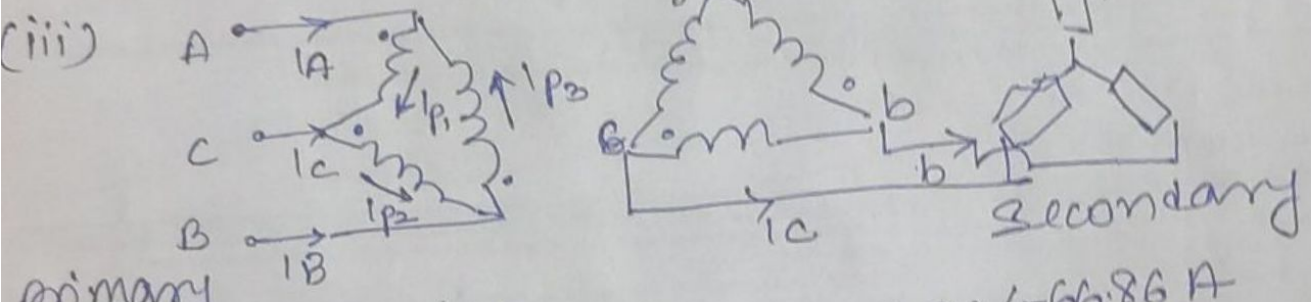
$I_{p_2} = 1.5 \angle -6.87$ A

(ii) power $= \sqrt{3} V_L I_L \cos\theta$.

$= \sqrt{3} \times 415 \times 23.96 \times \cos(-30 + 66.86)$

Power = 13.78 KW.

(iii)



primary

$V_{AB} = 6600 \angle 0^\circ$ V

$V_{BC} = 6600 \angle -120^\circ$ V

$V_{CA} = 6600 \angle 120^\circ$ V

$V_{ab} = 415 \angle 0^\circ$ V

$V_{bc} = 415 \angle -120^\circ$ V

$V_{ca} = 415 \angle 120^\circ$ V

$V_{an} = 415/\sqrt{3} \angle -30^\circ$ V

$V_{bn} = 415/\sqrt{3} \angle -150^\circ$ V

$V_{cn} = 415/\sqrt{3} \angle 90^\circ$ V.

$I_a = 23.96 \angle -66.86$ A

$I_b = 23.96 \angle 173.13$ A

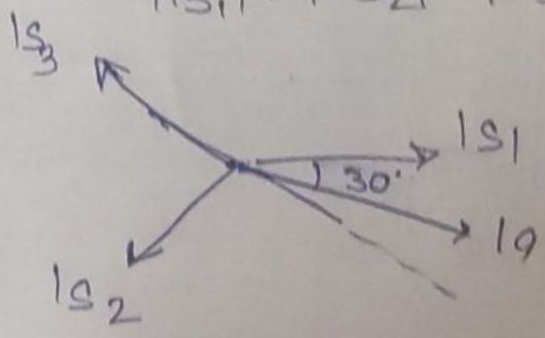
$I_c = 23.96 \angle 53.13$ A.

$I_{s_1} - I_{s_3} = I_a$

$I_{s_2} - I_{s_1} = I_c$

$I_{s_3} - I_{s_2} = I_b$.

$|I_{s_1}| = |I_{s_2}| = |I_{s_3}|$.



$I_a = \sqrt{3} I_{s_1} \angle -30°$

or $I_{s_1} = \frac{1}{\sqrt{3}} I_a \angle 30°$

$I_{s_1} = 13.83 \angle -26.86° A$

$I_{s_2} = \frac{1}{\sqrt{3}} I_c \angle 30° = 13.83 \angle 83.13° A$

$I_{s_3} = \frac{1}{\sqrt{3}} I_b \angle 30° = 13.83 \angle -156.87° A$

} secondary phase currents

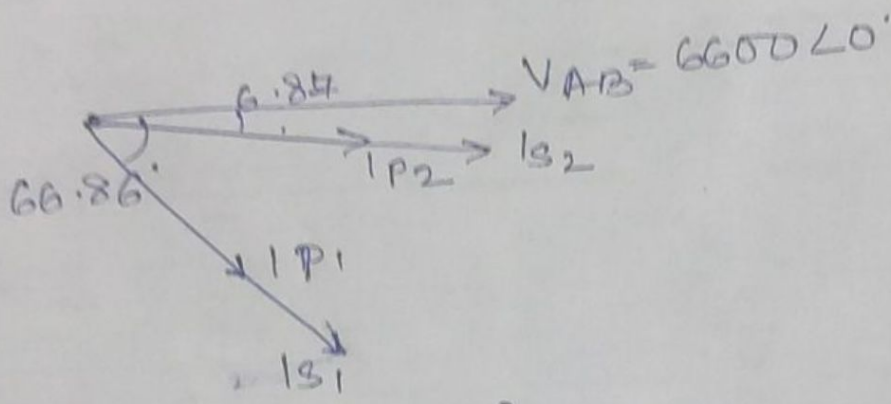
$I_{p_1} = 0.87 \angle -36.86° A$

$I_{p_2} = 0.87 \angle 86.13° A$

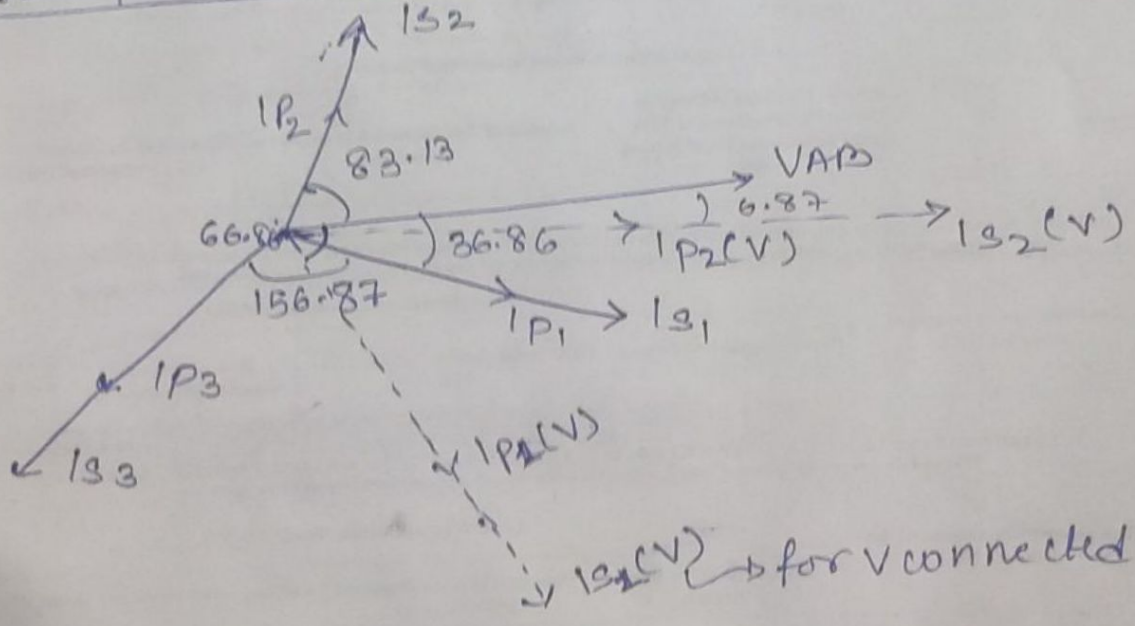
$I_{p_3} = 0.87 \angle -156.87° A$

} primary phase currents

phasor for V connected transformer:



phasors for Δ-Δ transformer:



Q2 Scott connected transformer

415V (L-L) 3phase 50Hz → two 120V 1phase supply

SP_1 leads SP_2 by 90°

load on SP_1 = 400KW at 0.8pf (lag)

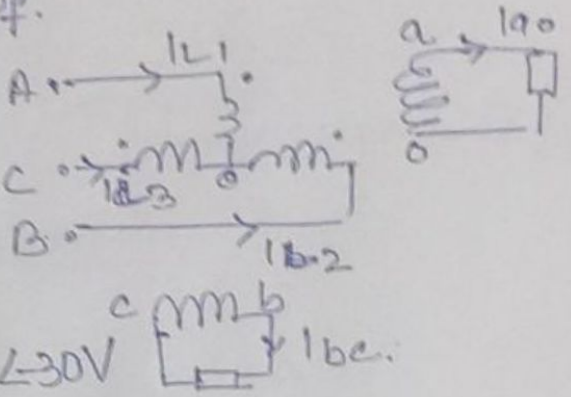
load on SP_2 = 900KW at 1pf.

V_{AB} → reference.

$V_{AB} = 415\angle 0\ V$

$V_{BC} = 415\angle -120\ V$

$V_{CA} = 415\angle 120\ V.$



$|V_{AO}| = \frac{\sqrt{3}}{2} 415.$

$V_{AO} = \frac{\sqrt{3}}{2} 415\angle -30°\ V = 359.4\angle -30\ V$

$V_{ao} = n_1 V_{AO}$

$V_{bc} = n_2 V_{BC}.$

$n_1 = \frac{V_{ao}}{V_{AO}} = \frac{120}{359.4} = 0.333$

$n_2 = \frac{V_{bc}}{V_{BC}} = \frac{120}{415} = 0.289$

$V_{ao} = 120\angle -30°\ V$

$V_{bc} = 120\angle -120°\ V.$

$I_{ao} = \frac{400 \times 10^3}{120 \times 0.8}\angle 30 - 36.85$

$= 4166.67\angle -66.85$ A.

$I_{bc} = \frac{900K 10^3}{120 \times 1}\angle -120$

$= 7500\ A\angle -120.$

Line currents are:

$I_{AO} = n_1 I_{ao} = 1.37\angle -66.85\ KA = I_{L1}$

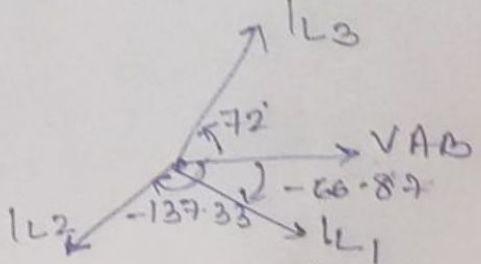
$I_{BC} = n_2 I_{bc} = 2.167\angle -120°\ KA$

$I_{L3} = I_{BC} - I_{AO}/2 = 1.83\angle -137.33\ KA$

$I_{L2} = -I_{BC} - I_{AO}/2 = 2.63\angle 72°\ KA$

$I_{L1} = 1.37\angle -66.85°\ KA$
$I_{L2} = 2.63\angle 72°\ KA$
$I_{L3} = 1.83\angle -137.33°\ KA$

Line currents.



phasor diagram.