CALCULATION OF POWER IN FOUR WIRE STAR CONNECTED UNBALANCED LOADS

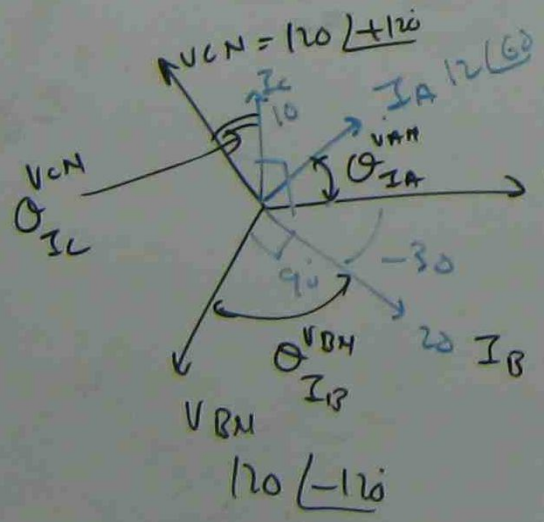
FOR 3ϕ BALANCED LOAD 3ϕ POWER $= \sqrt{3}\, E\, I \cos\theta$

FOR 3ϕ UNBALANCED LOAD, THE ABOVE FORMULA CAN NOT BE USED

$$3\phi \text{ POWER} = V_{AN} I_A \cos\theta_{IA}^{V_{AN}} + V_{BN} I_B \cos\theta_{I_B}^{V_{BN}} + V_{CN} I_C \cos\theta_{I_C}^{V_{CN}}$$

Ph 3ϕ 208 V ABC, $Z_A = 10\angle -60$, $Z_B = 6\angle -90$, $Z_C = 12\angle 30$. FIND 3ϕ POWER

$$V_{AN} = \frac{208}{\sqrt{3}} = 120 \text{ V}$$



$$\bar{I}_A = \frac{\bar{V}_{AN}}{Z_A} = \frac{120\angle 0}{10\angle -60} = 12\angle 60 \text{ A}$$

$$\bar{I}_B = \frac{\bar{V}_{BN}}{Z_B} = \frac{120\angle -120}{6\angle -90} = 20\angle -30 \text{ A}$$

$$\bar{I}_C = \frac{\bar{V}_{CN}}{Z_C} = \frac{120\angle 120}{12\angle 30} = 10\angle 90 \text{ A}$$

$\theta_{I_A}^{U_{AN}} = 60^\circ$, $\theta_{I_B}^{U_{BN}} = 90^\circ$

$\theta_{I_C}^{U_{CN}} = 30^\circ$

$P_A = V_{AN} I_A \cos \theta_{I_A}^{U_{AN}}$

$= 120 \times 12 \times \cos 60 = 720$ WATT

$P_B = V_{BN} I_B \cos \theta_{I_B}^{U_{BN}}$

$= 120 \times 20 \times \cos 90 = 0$ WATT

$P_C = V_{CN} I_C \cos \theta_{I_C}^{U_{CN}}$

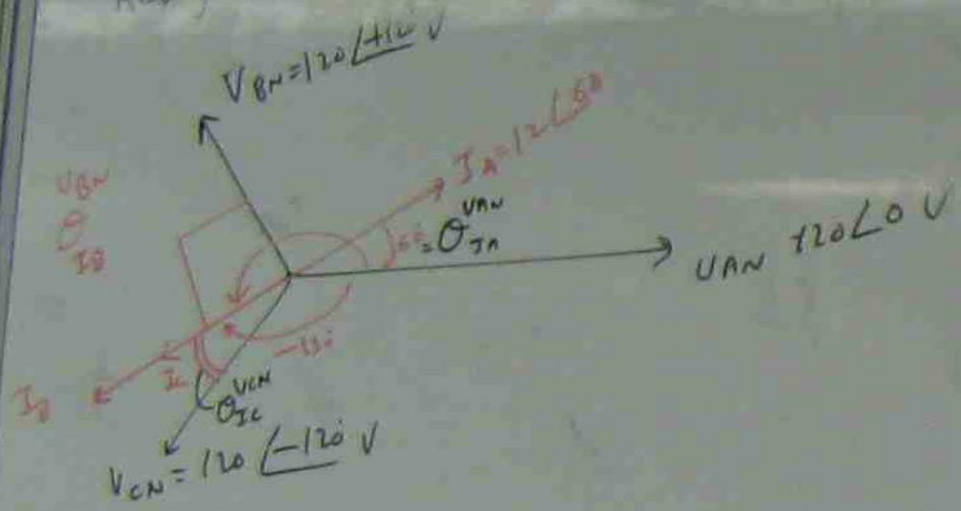
$= 120 \times 10 \times \cos 30 = 1039$ WATT

$P_T = P_A + P_B + P_C$

$= 720 + 0 + 1039$

$= 1759$ WATT

Pb IN ABOVE PROBLEM, IF THE PHASE SEQUENCE IS CHANGED TO ACB, FIND TOTAL 3ϕ POWER



$$\bar{I}_A = \frac{\bar{V}_{AN}}{Z_A} = \frac{120\angle 0}{10\angle -60} = 12\angle 60° \text{ A}$$

$$\bar{I}_B = \frac{\bar{V}_{BN}}{Z_B} = \frac{120\angle 120}{6\angle -90} = 20\angle 210° \text{ A}$$

$$\bar{I}_C = \frac{\bar{V}_{CN}}{Z_C} = \frac{120\angle -120}{12\angle 30} = 10\angle -150° \text{ A}$$

GED TO

$\theta_{I_A}^{V_{AN}} = 60$

$\theta_{I_B}^{V_{BN}} = 90$

$\theta_{I_C}^{V_{CN}} = 30$

$P_A = V_{AN} I_A \cos \theta_{I_A}^{V_{AN}} = 120 \times 12 \cos 60 = 720\ W$

$P_B = V_{BN} I_B \cos \theta_{I_B}^{V_{BN}} = 120 \times 20 \cos 90 = 0$

$P_C = V_{CN} I_C \cos \theta_{I_C}^{V_{CN}} = 120 \times 10 \cos 30 = 1039\ W$

$P_T = P_A + P_B + P_C$

$= 720 + 0 + 1039$

$= 1759\ W$

BY REVERSING THE PHASE SEQUENCE

(1) LINE CURRENT MAGNITUDE — THE SAME / PHASE ANGLE DIFFERENT

(2) DIFFERENT NEUTRAL CURRENT

(3) THE SAME TOTAL 3ϕ POWER.