Sec (12) الأخير

Sheet(10) → Three phase system

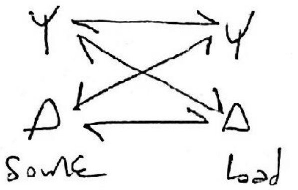
الجزء الأهم من ص ١٤ - ١٦

Threephase نظري (1) | ملاحظة مقرر صفحات ١٤ ← ١٦

3-Sources Connected to 3 loads using 3 or 4 wire system
- ↳ Balanced → Sources have equal Freq. but different phases
- ↳ Unbalanced

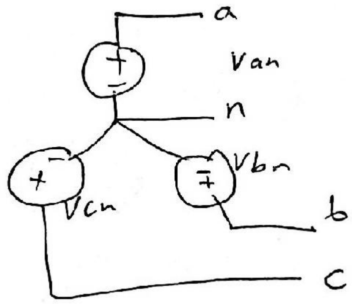
* 3phase used in All world to generate, Transmit, Distribute Power.

* Balanced 3 ϕ ≡ 3 single phase Voltage Sources connected either as Y or Δ to 3 loads connected as Y or Δ

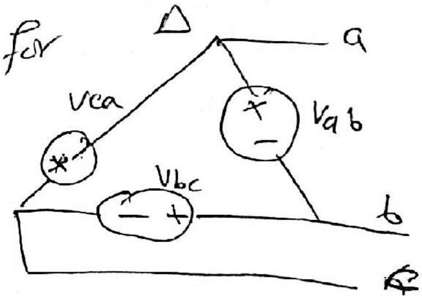


Y – Y
Y – Δ
Δ – Y
Δ – Δ

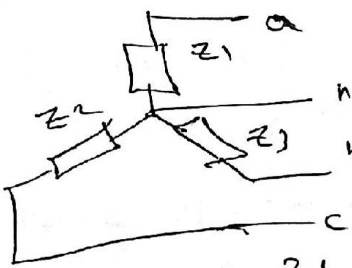
* ex for Y generators/source

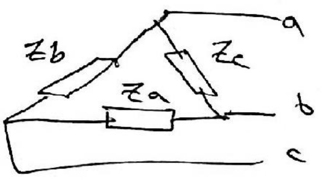


* ex for Δ



* ex for Y load





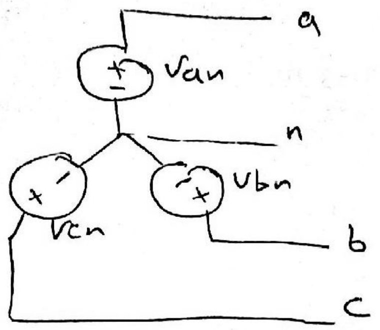
Zc بين b c a بين
وهكذا Zb — a c ~

Notes $Z_1 = Z_2 = Z_3 = Z_Y$ Balanced load & $Z_a = Z_b = Z_c = Z_\Delta$ Balanced load

for Balanced load $Z_Y = \frac{Z_\Delta}{3}$

②

Phase sequence

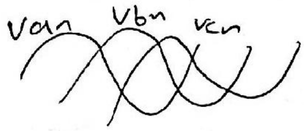


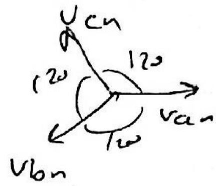
$v_{an}(t) = \sqrt{2} V_p \cos\omega t = V_p \angle 0°$

$V_{bn} = \sqrt{2} V_p \cos(\omega t - 120) = V_p \angle -120$

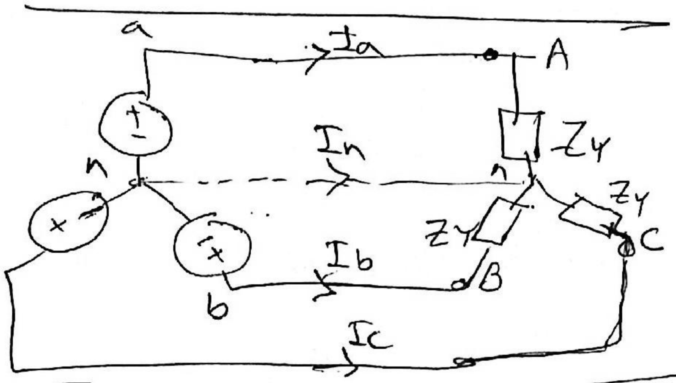
$V_{cn} = \sqrt{2} V_p \cos(\omega t + 120) = V_p \angle 120$

RMS





1 Y-Y



reference

ⓐ $V_{an} = V_p \angle 0$
$V_{bn} = V_p \angle -120$
$V_{cn} = V_p \angle 120$
} phase Voltages

ⓑ $I_a = \frac{V_p \angle 0}{Z_Y}$
$I_b = \frac{V_p \angle -120}{Z_Y} = I_a \angle -120$
$I_c = \frac{V_p \angle +120}{Z_Y} = I_a \angle 120$

ⓒ $V_{ab} = V_a - V_b = (V_a - V_n) - (V_b - V_n) = V_{an} - V_{bn}$

$= V_p \angle 0 - V_p \angle -120 = V_p \cos\omega t - V_p \cos(\omega t - 120)$

$= V_p \{\cos\omega t - [\cos\omega t \cos -120 + \sin\omega t \sin 120]\}$

$= V_p [\cos\omega t + \frac{1}{2}\cos\omega t + \frac{\sqrt{3}}{2}\sin\omega t)$

$= V_p [\frac{3}{2}\cos\omega t + \frac{\sqrt{3}}{2}\sin\omega t] = \sqrt{3} V_p [\frac{\sqrt{3}}{2}\cos\omega t + \frac{1}{2}\sin\omega t]$

$= V_p \cos(\omega t + \phi) \rightarrow \phi = \tan^{-1}\left(\frac{1/2}{\sqrt{3}/2} = \frac{1}{\sqrt{3}}\right) = 30°$

$= \sqrt{3} V_p \cos(\omega t + 30°) = \sqrt{3} V_p \angle 30°$

so

$V_{ab} = \sqrt{3} V_p \angle 30°$
$V_{bc} = \sqrt{3} V_p \angle -90$
$V_{ca} = \sqrt{3} V_p \angle 150$

phase لشتغل فقط أول حرف بيكون تاني
مطروح منه 120 والتالت عليه 120

$V_{LN} = V_L / \sqrt{3}$, $I_L = V_{LN} / Z$

an, bn, cn

Ref ex $V_{BA} = V \angle 30$ Ref
$V_{an} = \text{Ref} + 120 = V \angle +120$
$V_{cn} = \text{Ref} + 240 = V \angle 240$

Phasors لرسم الـ

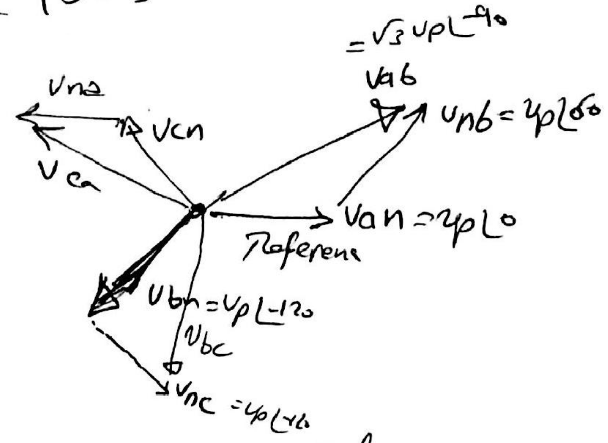
$V_{ab} = V_{an} + V_{nb}$

$= \sqrt{3} V_p \angle 30$

$V_{bc} = V_{bn} + V_{nc}$

$= \sqrt{3} V_p \angle -90$

$V_{ca} = V_{cn} + V_{na} = \sqrt{3} V_p \angle 150$



- نرسم اولاً $V_{an} = V_p \angle 0$ (Reference) ← ثم $V_{nb} = V_p \angle 60$ ∴ الجمع V_{ab}

- " $V_{bn} = V_p \angle -120$ ← ثم $V_{nc} = -V_{cn} = -V_p \angle +120$

- " $V_{cn} = V_p \angle 120$ ← ثم $V_{na} = -V_{an} = -V_p \angle 0$

أو طريقة أخرى اولاً رسم V_{an} ، V_{cn} ، V_{bn}

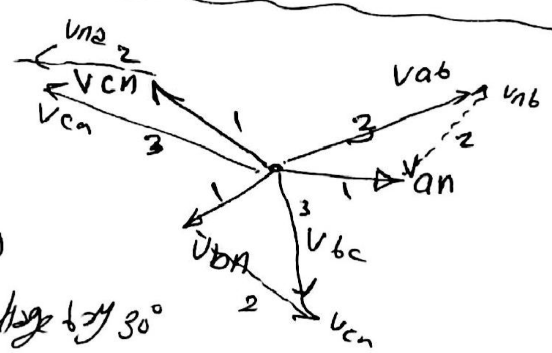
رسم V_{ab} ، V_{bc} ، V_{ca} } مانحتاج الى V_{nb} ، V_{nc} ،

Note :- Load Voltage $= V_L = \sqrt{3} V_p$

$V_L = |V_{ab}| = |V_{bc}| = |V_{ca}|$

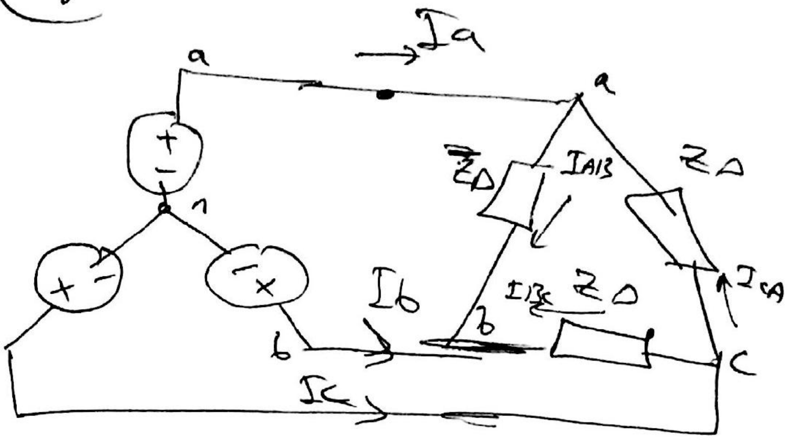
and $V_p = |V_{an}| = |V_{bn}| = |V_{cn}|$

Line voltage lead phase voltage by 30°



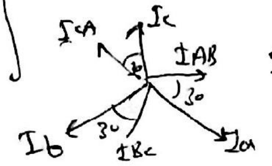
(4)

(2) $3\phi \rightarrow Y-\Delta$



* $V_{an} = V_p\angle 0$
* $V_{bn} = V_p\angle -120$
* $V_{cn} = V_p\angle 120$

* $V_{ab} = \sqrt{3}V_p\angle 30 = V_{AB}$
* $V_{bc} = \sqrt{3}V_p\angle -90 = V_{BC}$
* $V_{ca} = \sqrt{3}V_p\angle 150^\circ = V_{CA}$



$I_{AB} = \frac{V_{AB}}{Z_\Delta}$

$I_{BC} = \frac{V_{BC}}{Z_\Delta}$

$I_{CA} = \frac{V_{CA}}{Z_\Delta}$

Phase curnt

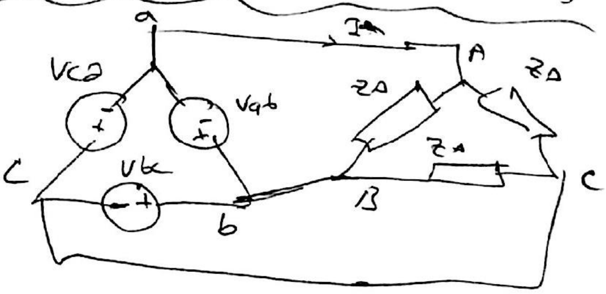
$I_a = I_{AB} - I_{CA} = \sqrt{3}I_{AB}\angle -30^\circ$

$I_b = I_{BC} - I_{AB} = \sqrt{3}I_{BC}\angle -30^\circ$

$I_c = \sqrt{3}I_{CA}\angle -30^\circ$

line curnt

(3) $\Delta - \Delta$



no neutral

$V_{ab} = V_p\angle 0 = V_{AB}$, $I_{AB} = \frac{V_{AB}}{Z_\Delta}$

$V_{bc} = V_p\angle -120 = V_{BC}$, $I_{BC} = V_{BC}/Z_\Delta$

$V_{ca} = V_p\angle 120 = V_{CA}$, $I_{CA} = V_{CA}/Z_\Delta$

~~$V_{ab} = V_{AB}$~~

$I_a = I_{AB} - I_{CA} = \sqrt{3}I_{AB}\angle -30$

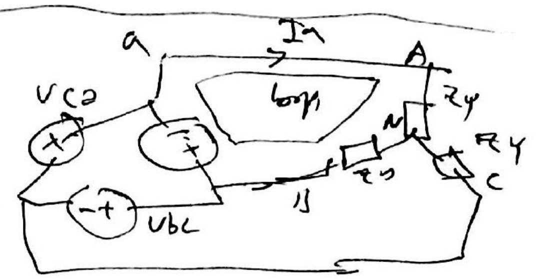
$I_b = \sqrt{3}I_{BC}\angle -30$

$I_c = \sqrt{3}I_{CA}\angle -30$

line curnt

(4) $\Delta - Y$ (Y load – Δ load)

Take loops



$V_{ab} = V_p\angle 0$

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

$V_{ca} = V_p\angle 120^\circ$

loop 1

$-V_{ab} + Z_Y I_a - Z_Y I_b = 0$

$I_a - I_b = V_{ab}/Z_Y$

→ for Balance ϕ $I_b = I_a\angle -120$ ∴ $I_a - I_b = I_a\sqrt{3}\angle 30$

$= \frac{V_p/\sqrt{3}}{Z_Y}\angle -30^\circ$

~~I_c, I_b ... 2 loops~~

$P_T = \sqrt{3}V_L I_L \cos\theta$

$S_T = \sqrt{3}V_L I_L$

$Q_T = \sqrt{3}V_L I_L \sin\theta$

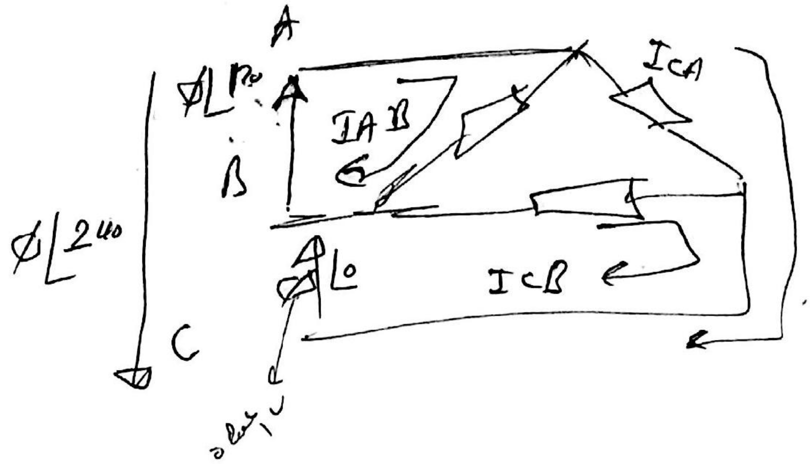
∵ $I_a = \frac{V_p/\sqrt{3}}{Z_Y}\angle -30$

$I_a\angle -120 = I_b$

$I_a\angle +120 = I_c$

unbalanced

[1] 3φ - 3 wire



$I_{AB} = V_{AB}/Z_{AB}$

$I_{BC} = V_{BC}/Z_{BC}$

$I_{CA} = V_{CA}/Z_{CA}$

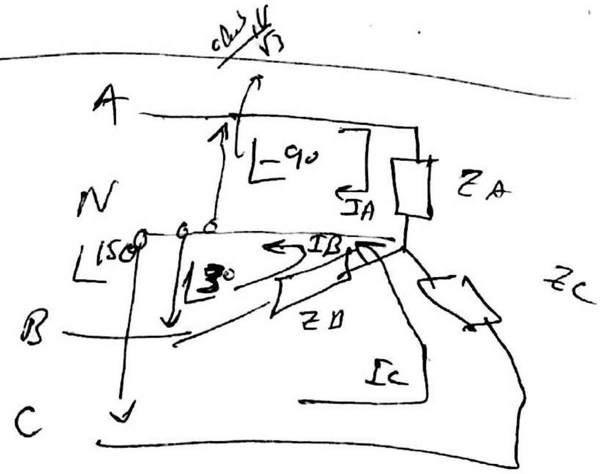
$I_A = I_{AB} + I_{AC}$

$I_B = I_{BA} + I_{BC}$

$I_C = I_{CA} + I_{CB}$

---

(2) 4-wire - Y load



$I_A = V_{AN}/Z_A$

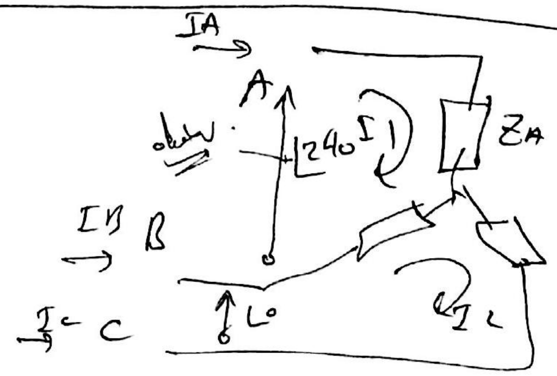
$I_B = V_{BN}/Z_B$

$I_C = V_{CN}/Z_C$

$I_N = -(I_A + I_B + I_C)$

---

(3) 3 wire → Y load



KVL

$V_{ab} = I_1 Z_A - I_2 Z_B$

$V_{BC} = (I_2 - I_1) Z_B + I_2 Z_C$

[illegible]

$I_A = I_1$, $I_B = I_2 - I_1$, $I_C = -I_2$

تتبقى جزئية الـ Power موجودة في slides ولها أمثلة كتير

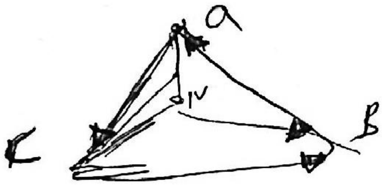
بعد امتحان 6

(6) لاالصفر عمود

ممكن أغير ال Reference ويكون بتاع أي Phase

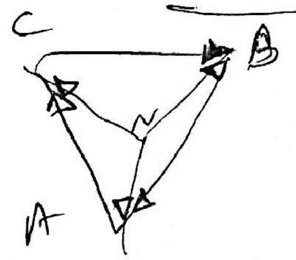
ex: Let V_{BC} Ref for Balanced load

ABC seq



source 3 wire	load 4 wire
$V_{AB} = V_L \angle 120$	$V_{AN} = \frac{V_L}{\sqrt{3}} \angle 90$
$V_{BC} = V_L \angle 0$	$V_{BN} = V_L/\sqrt{3} \angle -30$
$V_{CA} = V_L \angle 240 \to -120$	$V_{CN} = V_L/\sqrt{3} \angle -150$

CBA seq



source 3 wire	source 4 wire
$V_{AB} = V_L \angle 240$	$V_{AN} = V_L/\sqrt{3} \angle -90$
$V_{BC} = V_L \angle 0$	$V_{BN} = V_L/\sqrt{3} \angle 30$
$V_{CA} = V_L \angle 120$	$V_{CN} = V_L/\sqrt{3} \angle 150$

3 wire | 4 wire

	AB Ref		BC Ref		CA Ref
$V_{AB} =$	$V_L \angle 0$	$\to$	$V_L \angle 120$	$\to$	$V_L \angle -120$ or $V_L \angle 240$
$V_{BC} =$	$V_L \angle -120$	$\to$	$V_L \angle 0$	$\to$	$V_{BC} \angle -240$ or $V_L \angle 120$
$V_{CA} =$	$V_L \angle +120$	$\to$	$V_L \angle 240$	$\to$	$V_L \angle 0$ or $V_L \angle 360$

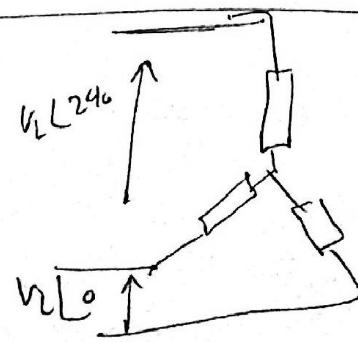
$V_{CA} \to V_{AB} \to V_{BC}$

or V_1

For Balanced $P = \sqrt{3} V_L I_L \cos\theta_L$

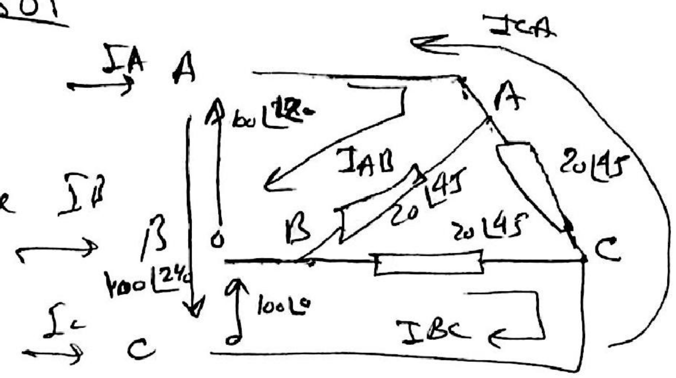
$\theta_L \to$ angle bet V_{AB}, I_{AB} / V_{BC}, I_{BC} / I_{CA}, V_{CA}

for 3 wire Y



10 مسائل

[1] 3φ * 3 wire * 100V * ABC sys supplies a balanced Δ load with impedance $20\angle 45°$, find I_{Line}, draw phasors



Let V_{BC} Reference $100\angle 0$

Sup's:
$V_{AB} = 100\angle 120$
$V_{CA} = 100\angle 240$

phase voltage = load voltage

Phase wat:

$$I_{AB} = \frac{V_{AB}}{Z_{AB}} = \frac{100\angle 120}{20\angle 45} = 5\angle 75°$$

$$I_{BC} = \frac{V_{BC}}{Z_{BC}} = \frac{100\angle 0}{20\angle 45} = 5\angle -45$$

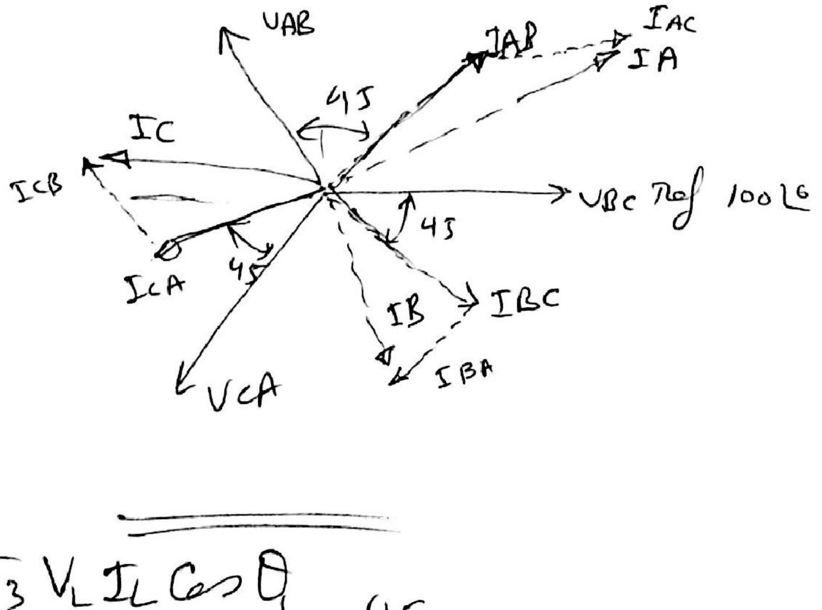
$$I_{CA} = \frac{V_{CA}}{Z_{CA}} = \frac{100\angle 240}{20\angle 45} = 5\angle 195$$

Load current:

$$I_A = I_{AB} - I_{CA} = I_{AB} + I_{AC} = 5\angle 75 - 5\angle 195 = 8.66\angle 45$$

$$I_B = I_{BC} - I_{AB} = I_{BC} + I_{BA} = 5\angle -45 - 5\angle 75 = 8.66\angle -75$$

$$I_C = I_{CA} - I_{BC} = 5\angle 195 - 5\angle -45 = 8.66\angle 165$$



$$P = \sqrt{3}\, V_L I_L \cos\theta$$

$V_L \to 100$, $I_L \to 8.66$, $\theta \to 45$

$I_{AB} \angle V_{AB}$ = زاوية
$I_{BC} \angle V_{BC}$
$I_{CA} \angle V_{CA}$

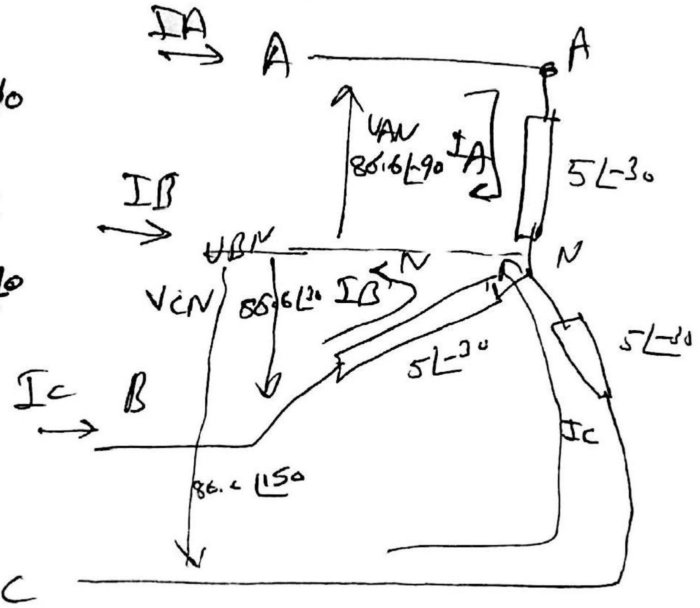
[2] 3 identical impedance of $5\angle-30$, connected in Y to 3ϕ of 3 wire 150V, CBA sy find I_L, Phasors

for CBA sy (C) before

$V_{AN} = V_L/\sqrt{3}\ \angle -90$, $V_{AB} = V_L \angle 240$

$V_{BN} = V_L/\sqrt{3}\ \angle +30$, $V_{BC} = V_L \angle 0$

$V_{CN} = V_L/\sqrt{3}\ \angle +150$, $V_{CA} = V_L \angle 120$



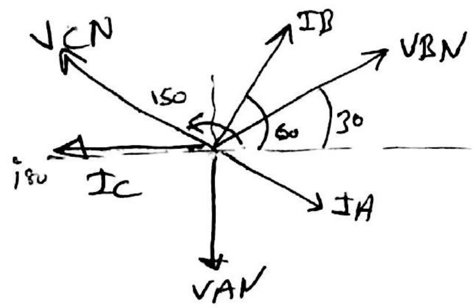
$V_{LN} = V_L/\sqrt{3} = 150/\sqrt{3} = 86.6$

$I_A = V_{AN} / 5\angle-30$

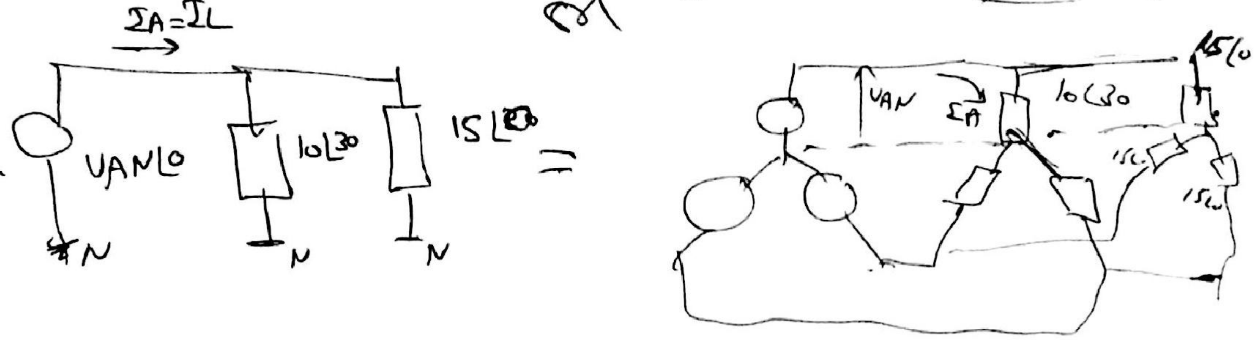
$$I_A = \frac{V_L/\sqrt{3}\ \angle-90}{5\angle-30} = \frac{150/\sqrt{3}}{5} \angle{-9-(-30)} = 17.3\angle-60$$

$$I_B = V_{BN}/5\angle-30 = \frac{V_L/\sqrt{3}\ \angle 30}{5\angle-30} = 17.32\angle 60$$

$$I_C = \frac{V_{CN}}{Z} = \frac{V_L/\sqrt{3}\ \angle 150}{5\angle-30} = 17.32\angle 180$$



3) 3 identical impedance of $10\angle 30^\circ$ in Y connection & 3 impedance of $15\angle 0$ also in Y are both in same 3 phase, 250 V (ABC seq) find total power of



$|V_{AN}| = \frac{|V_L|}{\sqrt{3}} = \frac{250}{\sqrt{3}} = 144.5$, $P = \sqrt{3}\, V_L I_L \cos\theta$

$I_L = I_A = I_{10\angle 30} + I_{15\angle 0} = \frac{V_{AN}}{10\angle 30} + \frac{V_{AN}}{15\angle 0}$

for ABC seq
$V_{AN}\angle 0$
$V_{BN}\angle -120$
$V_{CN}\angle 120$

$I_L = \frac{144.5\angle 0}{10\angle 30} + \frac{144.5\angle 0}{15\angle 0} = 23.2\angle -18.1$

ويعتبر زاوية تشكل عادي مع العلاقة $A+jB$ عمر متوازي أنا مش دائر

$P = \sqrt{3}\, V_L I_L \cos\theta = \sqrt{3}(250)(23.2)\cos(-18.1) = 9530\,W$

الزاوية I_L , V_L

Another Ans

$V_{AN} = \frac{V}{\sqrt{3}}\angle 90$
$V_{BN} = \angle -30$
$V_{CN}\ \angle -150$

حلاً و بيعمله

$I_L = \frac{144.5\angle 90}{10\angle 30} + \frac{144.5\angle 90}{15\angle 0} = 23.27\angle 71.9$ ($|I_L|$)

$\theta_{impedance} = |\theta_I - \theta_V| = 90 - 71.9 = 18.1$

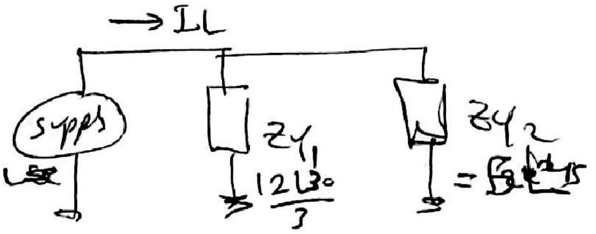
$\therefore P_L = \sqrt{3}\, V_L I_L \cos\theta = \sqrt{3} \times 250 \times 23.27 \times \cos 18.1$
$= 9530\,W$

(4) 3 identical impedance of $12\angle 30$ in Δ connection, and 3 identical " of $5\angle 45^\circ$ in Y, connected same 3 wire, 3φ (208 V) ABC sys → find I_L, P_{total}

Sol

اولاً حول Δ لـ Y ← $\frac{Z_\Delta}{3} = Z_Y$ وبعدها نوازي

① $Z_Y = \frac{12\angle 30^\circ}{3} = 4\angle 30$



② $V_{supply} = \frac{V_{Line}}{\sqrt{3}} = \frac{208}{\sqrt{3}} = 120\,V$

③ $I_L = \frac{120\angle 0}{4\angle 30} + \frac{120\angle 0}{5\angle 45} = 53.6\angle -36.6^\circ$, $Z_{eq} = 2.24\angle 36$

in ABC

∴ $V_{AN} = \frac{V_L}{\sqrt{3}}\angle 90$ ∴ $I_A = \frac{V_{AN}}{Z_{eq}} = \frac{120\angle 90}{2.24\angle 36} = 53.6\angle 53.4$

$I_B = \frac{V_{BN}}{Z_{eq}} = \frac{120\angle -30}{2.24\angle 36} = 53.6\angle -66.6$

$I_C = \frac{V_{CN}}{Z_{eq}} = \frac{120\angle -150}{2.24\angle 36} = 53.6\angle -186.6^\circ$

V_{AN}, V_{BN}, V_{CN} → for ABC sys

ref V_{BC} ... 3, 4

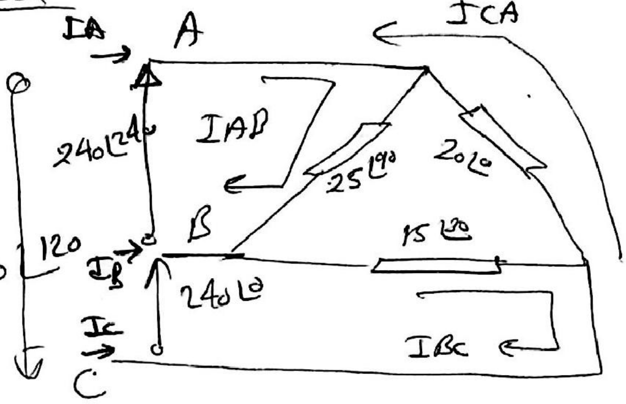
ref V_{AB} ...

$P_t = \sqrt{3} V_L I_L \cos\theta = \sqrt{3}(208)(53.6)\cos(36.6)$

V_L, I_L

(5) 3ϕ, 3 wire, 240V, (CBA) sys, supply Δ connected load in which $Z_{ab} = 25\angle 90$, $Z_{BC} = 15\angle 30$, $Z_{CA} = 20\angle 0$ find line current & total power

Sol



phase current:

$$I_{AB} = \frac{V_{AB}}{Z_{AB}} = \frac{240\angle 240}{25\angle 90} = 9.6\angle 150$$

$$I_{BC} = \frac{V_{BC}}{Z_{BC}} = \frac{240\angle 0}{15\angle 30} = 16\angle -30$$

$$I_{CA} = \frac{V_{CA}}{Z_{CA}} = \frac{240\angle 120}{20\angle 0} = 12\angle 120$$

for CBA

line current $I_A = I_{AB} - I_{CA} = I_{AB} + I_{AC} = 6.6\angle 247.7^\circ$

$I_B = I_{BC} - I_{AB} = I_{BC} + I_{BA} = 25.6\angle -30$

$I_C = I_{CA} - I_{BC} = 27.1\angle 137.2^\circ$

→ to calc. Power in load

$Re\, Z_1 = Re(25\angle 90) = 25\cos 90 + j25\sin 90 = 0$

$Z_2 = 15\angle 30 = 13 + j7.5$

$Z_3 = 20\angle 0 = 20$

$$P_T = P_{load1} + P_{load2} + P_{load3}$$

$$= I_1^2 Z_1^{Re} + I_2^2 Z_2^{Re} + I_3^2 Z_3^{Re}$$

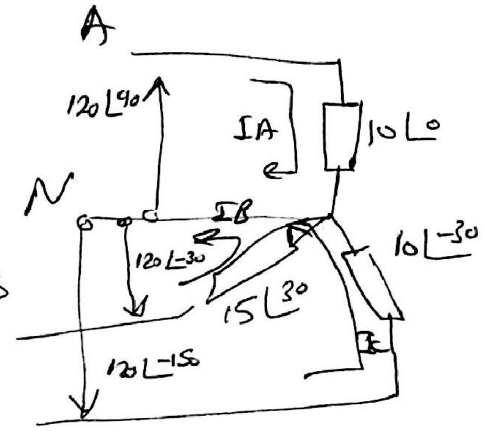
$$= I_{AB}^2 Z_{AB} + I_{BC}^2 Z_{BC} + I_{CA}^2 Z_{AC}$$

$$= (9.6)^2 \times 0 + (16)^2 \times 13 + (12)^2 \times 20 = 6210\,W$$

(6) 3ϕ, Four wire, 208V, ABC, Y Connected load

$Z_A = 10\angle 0$, $B = 15\angle 30$, $Z_C = 10\angle -30$, find I_L, I_N, P_t

<u>Sol</u>



Take V_{BC} Ref → ∵ for ABC sys. →

$I_A = V_{AN}/10\angle 0 = 120\angle 90/10\angle 0 = 12\angle 90$

$I_B = V_{BN}/15\angle 30 = 120\angle -30/15\angle 30 = 8\angle -60$ B

$I_C = V_{CN}/10\angle -30 = 120\angle -150/10\angle -30 = 12\angle -120$ C

$I_N = -(I_A + I_B + I_C) = 5.64\angle 69.4$

$V_{L} = 208/\sqrt{3} = 120$ (V_{ph}, V_{LN})

$P_t = P_A + P_B + P_C = I_A^2 Z_A + I_B^2 Z_B + I_C^2 Z_C$

5 / لأن ناخد فقط القيمة الحقيقية resistance (Z = complex هنا)

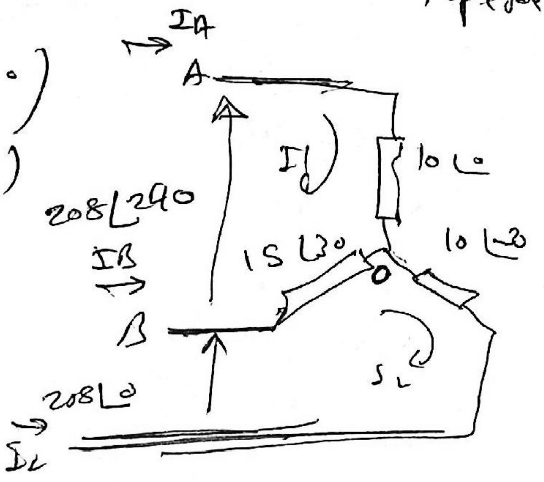
$\therefore P_A = I_A^2 Z_A = (12)^2 \times Re Z_A = (12)^2(10) = 1440$

$P_B = I_B^2 Z_B = (8)^2 \times Re Z_B = (64)(15\cos 30) = 832$ (13)

$P_C = I_C^2 Z_C = (12)^2 Re(Z_C) = (144)(10\cos 30) = 1247$

$\therefore P_t = 1440 + 832 + 1247 = 3519 W$

7 The load impedance of Prob(6) connected to 3ϕ, 3 wire 208 V ABC find the line currents and voltage across load impedance



Use Mesh

$$208\angle 240 = I_1(10\angle 0 + 15\angle 30) - I_2(15\angle 30)$$

$$208\angle 0 = I_2(10\angle -30 + 15\angle 30) - I_1(15\angle 30)$$

بحل المعادلتين معا ادخلها على الحاسبة

phasor

$$I_1 = 14.15\angle 86.1$$

$$I_2 = 10.15\angle 52.7$$

Line current

$$I_A = I_1 = 14.15\angle 86.1$$

$$I_B = I_2 - I_1 = 8\angle -49.5$$

$$I_C = -I_2 = 10.15\angle -127.3$$

$$-I_2 = -10.15\angle 52.2 = -[10.15\cos 52.2 + j\,10.15\sin 52.2]$$

phase voltage

$$V_{AO} = V_{Z1} = I_1 \times 10\angle 0 = (14.15\angle 86.1)(10\angle 0) = 141.5\angle 86.1$$

$$V_{Z2} = (I_2 - I_1)(15\angle 30) = (8\angle -49)(15\angle 30) = 120\angle -19.5$$

$$V_{Z3} = I_2 \times 10\angle -30 = (10.15\angle -127)(10\angle -30) = 101.5\angle -157.3^\circ$$

(14)

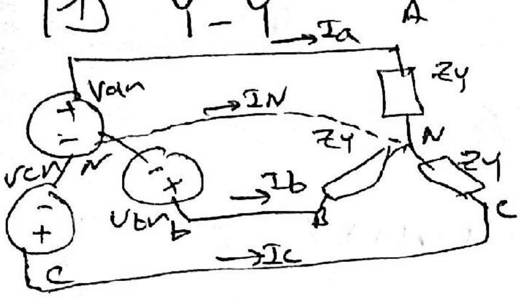
Three phase [illegible] خلاصة

1- Balanced sys

Connection	Phase Voltage / Current	Line voltage / current

$I_N + I_a + I_b + I_c = 0$

1 Y-Y



$V_{an} = V_p \angle 0$

$V_{bn} = V_p \angle -120$

$V_{cn} = V_p \angle +120$

I is the same line ⟵ I_{AB}, I_{BC}, I_{CA}

$V_{ab} = \sqrt{3} V_p \angle 30$

$V_{bc} = V_{ab} \angle -120$

$V_{ca} = V_{ab} \angle +120$

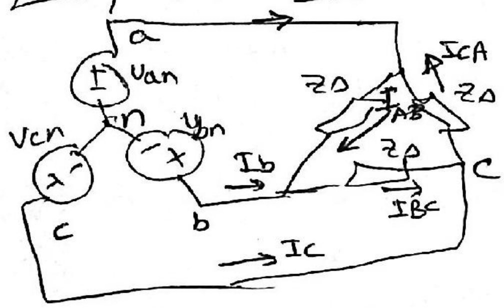
$I_a = V_{an}/Z_y$

$I_b = I_a \angle -120 = \frac{V_{bn}}{Z_y}$

$I_c = I_a \angle 120 = \frac{V_{cn}}{Z_y}$

$V_L = |V_{ab}| = |V_{bc}| = |V_{ca}| = \sqrt{3} V_p$, $V_p = V_L/\sqrt{3}$ [illegible] $= |V_{an}| = |V_{bn}| = |V_{cn}|$

2 Y-Δ



$V_{an} = V_p \angle 0$

$V_{bn} = V_p \angle -120$

$V_{cn} = V_p \angle +120$

$I_{AB} = V_{ab}/Z_\Delta$

$I_{BC} = V_{bc}/Z_\Delta$

$I_{CA} = V_{ca}/Z_\Delta$

$V_{ab} = V_{AB} = \sqrt{3} V_p \angle 30$

$V_{bc} = V_{ab} \angle -120$

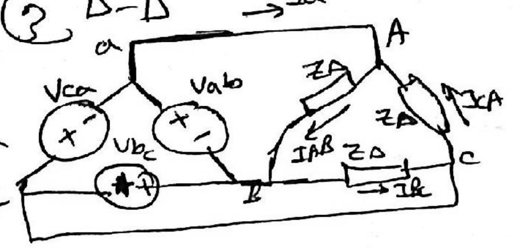
$V_{ca} = V_{ab} \angle 120$

$I_a = I_{AB}\sqrt{3} \angle -30 = I_{AB} - I_{CA}$

$I_b = I_a \angle -120 = I_{BC} - I_{AB}$

$I_c = I_a \angle 120$

3 Δ-Δ



$V_{ab} = V_p \angle 0$

$V_{bc} = V_p \angle -120$

$V_{ca} = V_p \angle 120$

} ⟶ same phase [illegible]

$I_{AB} = V_{ab}/Z_\Delta$

$I_{BC} = V_{bc}/Z_\Delta$

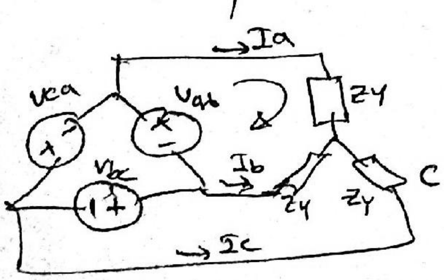
$I_{CA} = V_{ca}/Z_\Delta$

$I_a = I_{AB}\sqrt{3} \angle -30 = I_{AB} - I_{CA}$

$I_b = I_a \angle -120 = I_{BC} - I_{AB}$

$I_c = I_a \angle 120$

4 Δ-Y



$V_{ab} = V_p \angle 0$

$V_{bc} = V_p \angle -120$

$V_{ca} = V_p \angle 120$

⟵ Same Phase Voltage

Same Direction ⟵

$I_a = \frac{V_p}{\sqrt{3}} \frac{\angle -30}{Z_Y}$

$I_b = I_a \angle -120$

$I_c = I_a \angle 120$

for Δ or Y Balanced: $P_T = \sqrt{3} V_L I_L \cos\theta$, $S_T = \sqrt{3} V_L I_L$, $Q_T = \sqrt{3} V_L I_L \sin\theta$

where in Δ $I_L = \sqrt{3} I_p$ & in Y $V_L = \sqrt{3} V_p$

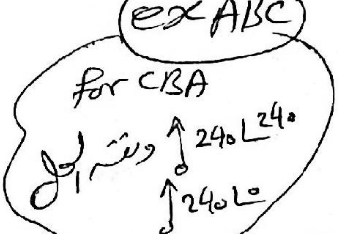
10 محاضرة (15)

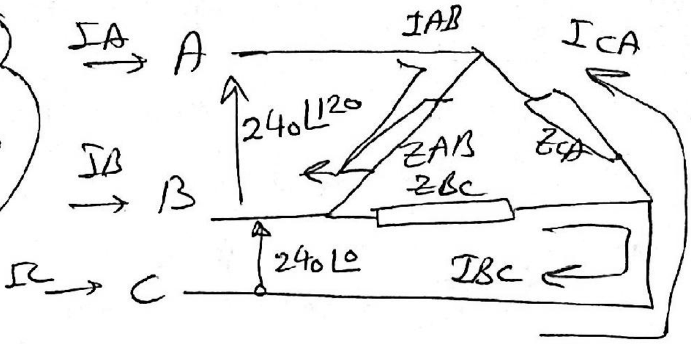
Unbalanced

① 3ϕ - 3wire Δ ABC or CBA sys

إذا $V_{line} = 240$

ex ABC





$I_{AB} = V_{AB} / Z_{AB}$

$I_{BC} = V_{BC} / Z_{BC}$

$I_{CA} = \frac{V_{CA}}{Z_{CA}}$

$I_A = I_{AB} - I_{CA}$, $I_B = I_{BC} - I_{AB}$, $I_C = I_{CA} - I_{BC}$

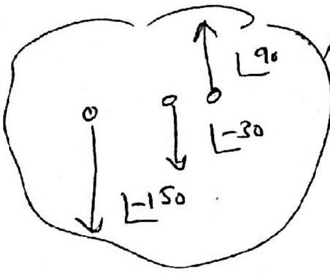
---

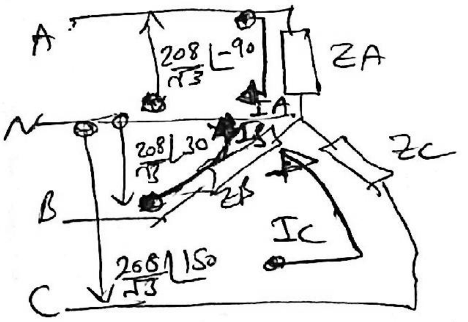
② 4 wire - Y ABC or CBA ex (CBA) $V_L = 208V$

أدرك طالما 4wire اقسم V_L لأجيب الطور علشان أ... على ($\sqrt{3}$) ونضع الزوايا كما بالشكل طالما CBA

أما لو ABC فعكسه

الزوايا فحسب عكسه





لا بد لو انفصل N يكون داخل

$I_A = V_{AN}/Z_A$, $I_B = V_{BN}/Z_B$, $I_C = V_{CN}/Z_C$

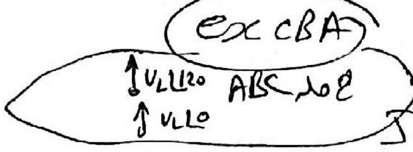
$I_N + I_A + I_B + I_C = 0$

(٤) لو 3wire بالحل نفسه ... 4wire

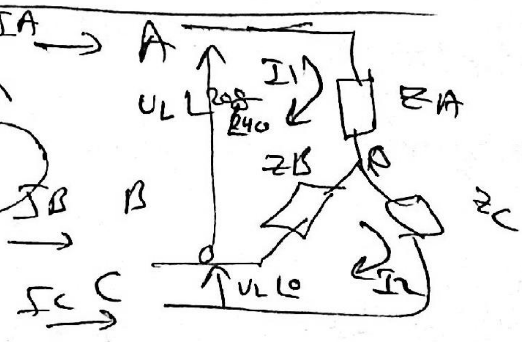
---

③ 3ϕ, 3wire Y (ABC) or (CBA)

ex CBA



meshloop



① $208\angle 240 = I_1(Z_A + Z_B) - I_2 Z_B$

$208\angle 0 = I_2(Z_B + Z_C) - I_1 Z_B$

ونحلهم نطلع الـ I

$I_A = I_1$, $I_B = I_2 - I_1$

$I_C = -I_2$

$V_{Ao} = V_{Z1} = I_1 Z_A$

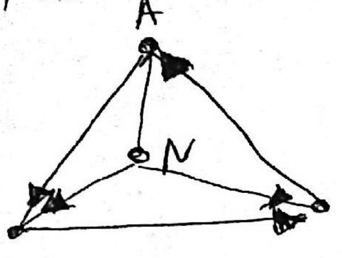
$V_{Bo} = V_{Z2} = (I_2 - I_1) Z_B$

$V_{Co} = (I_2) Z_C$

[illegible]

جميع مفتاح حل مسائل 3φ بأشكالها

1-ABC sy



بإفتراض إن Ref

وده بنفترض ان الجهد V_{CB} Ref

لو طلب in 3 wire ABC sy

جهود الـ Source كالتالي

$V_{AB} = V_L \angle 120$

$V_{BC} = V_L \angle 0$

$V_{CA} = V_L \angle 240$

4 wire ABC sy

نفتح الجهود

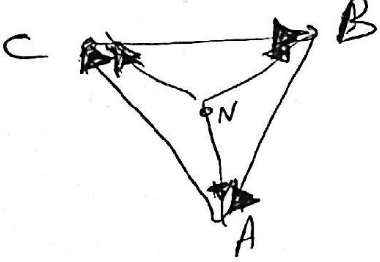
$V_{AN} = \left(\frac{V_L}{\sqrt{3}}\right) \angle 90$

$V_{BN} = \left(\frac{V_L}{\sqrt{3}}\right) \angle -30$

$V_{CN} = \left(\frac{V_L}{\sqrt{3}}\right) \angle -150$

ودي جهود الـ Source وجديدة المراية للـ load أيا كان شكله

2- CBA sy



3 wire

$V_{AB} = V_L \angle 240$

$V_{BC} = V_L \angle 0$

$V_{CA} = V_L \angle 120$

4 wire

$V_{AN} = (V_L/\sqrt{3}) \angle -90$

$V_{BN} = \left(\frac{V_L}{\sqrt{3}}\right) \angle +30$

$V_{CN} = \left(\frac{V_L}{\sqrt{3}}\right) \angle +150$

ويمكن تقسيم المسائل في حالتي Balanced & Unbalanced

① عندما لا يذكر ABC أو CBA (-1 القطعي انه ABC)

② لاحظ اسم ما يقول ABC/CBA 3 wire كأنه يقول الـ Source متصلة Δ

ABC/CBA 4 wire — — — Y

③ ولما يقول CBA 3 wire = Δ

وبالتالي ممكن تغير المسائل لتشمل CBA Δ-Δ أو

CBA/ABC - Three wire with loading Δ

CBA/ABC - Three wire with Y load.

وهكذا