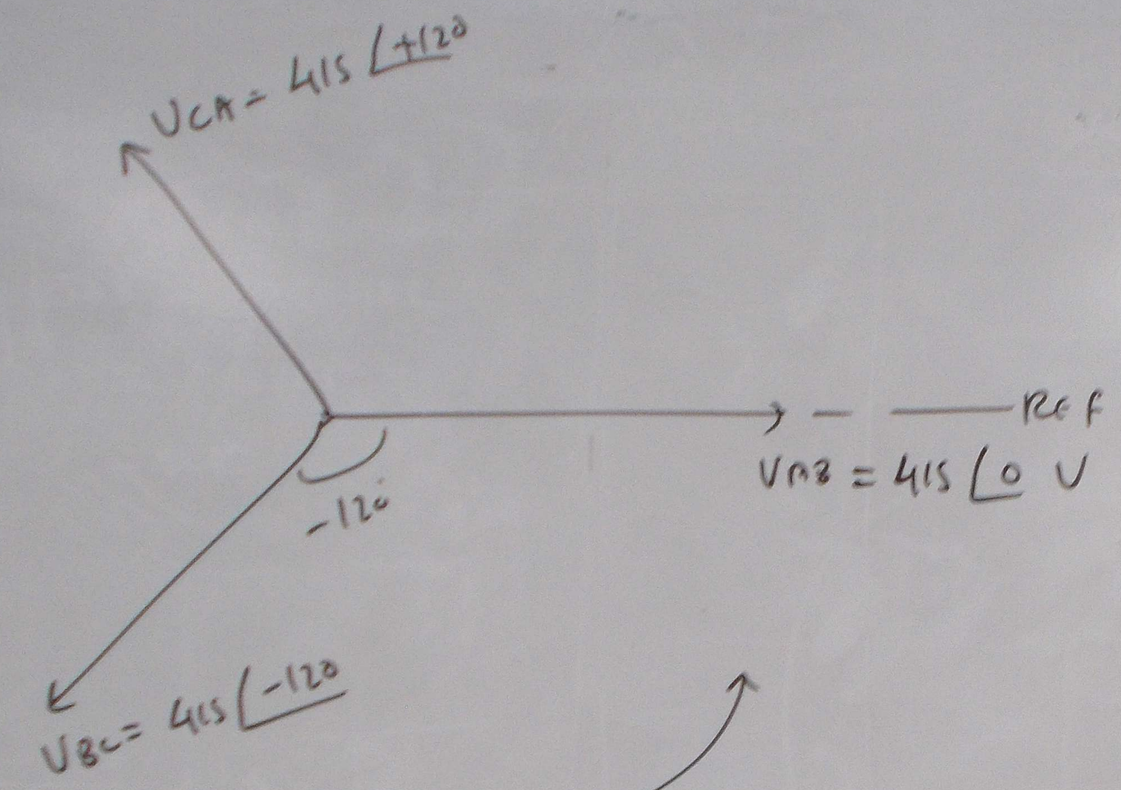


(a) $I_{ZA} = I_{AB} = \dfrac{V_{AB}}{Z_A} = \dfrac{415 \angle 0}{3+j4} = \dfrac{415 \angle 0}{\sqrt{3^2+4^2} \angle \tan^{-1} 4/3} = \dfrac{415}{5 \angle 53.2} = 83 \angle -53.2$ Amp

$I_{ZB} = I_{BC} = \dfrac{V_{BC}}{Z_B} = \dfrac{415 \angle -120}{3+j4} = \dfrac{415 \angle -120}{5 \angle 53.2} = 83 \angle -173.2$ Amp

$I_{ZC} = I_{CA} = \dfrac{V_{CA}}{Z_C} = \dfrac{415 \angle 120}{3+j4} = \dfrac{415 \angle 120}{5 \angle 53.2} = 83 \angle 66.8$ Amp

(b)

METHOD (1) BALANCED (ONLY MAGNITUDE)

$I_L = \sqrt{3}\, I_{AB} = \sqrt{3}\, I_{BC} = \sqrt{3}\, I_{CA}$

$= 1.7321 \times 83 = 143.76$ Amp

METHOD (2) ANY LOAD (MAGNITUDE + PHASE ANGLE)

(A) POINT $\quad I_{L_1} + I_{CA} = I_{AB}$

$I_{L_1} = I_{AB} - I_{CA}$

$= 83 \angle -53.2 - 83 \angle 66.8$

$= 83(\cos 53.2 - j \sin 53.2) - 83(\cos 66.8 + j \sin 66.8)$

$= 49.8 - j\,66.4 - 32.6 - j\,76.2$

$= 17.2 - j\,142.6$

$= \sqrt{17.2^2 + 142.6^2} \angle -\tan^{-1}\frac{142.6}{17.2}$

$= 143.6 \angle -83.12$ Amp

$\angle -53.2$ Amp

Amp

Amp

(B) POINT

$I_{L_2} + I_{AB} = I_{B}$

$I_{L_2} = I_{BC} - I_{A}$

$= 83 \angle -173.2$

$= 83(\cos(-173.2$

$= 83(-0.99$

$= -82.17 -$

$I = -131.9$

$= \sqrt{131.97^2}$

143

143

IV

I

II

III

(B) POINT

$I_{L_2} + I_{AB} = I_{BC}$

$I_{L_2} = I_{BC} - I_{AB}$

$= 83\angle -173.2 - 83\angle -53.2$

$= 83(\cos(-173.2) + j\sin(-173.2)) - [49.8 - j66.4]$

$= 83(-0.99 + (-j0.118)) - 49.8 + j66.4$

$= -82.17 - j9.794 - 49.8 + j66.4$

$= -131.97 + j56.6$

I

$= \sqrt{131.97^2 + 56.6^2} \angle +(180 - \tan^{-1}\frac{56.6}{131.97}$

+

$143.59\angle +(180 - 23.1)$

II

$143.59\angle +156.3$ Amp

C POINT

$I_{L_3} + I_{BC} = I_{CA}$

$I_{L_3} = I_{CA} - I_{BC}$

$= 83\angle 66.8 - 83\angle -173.2$

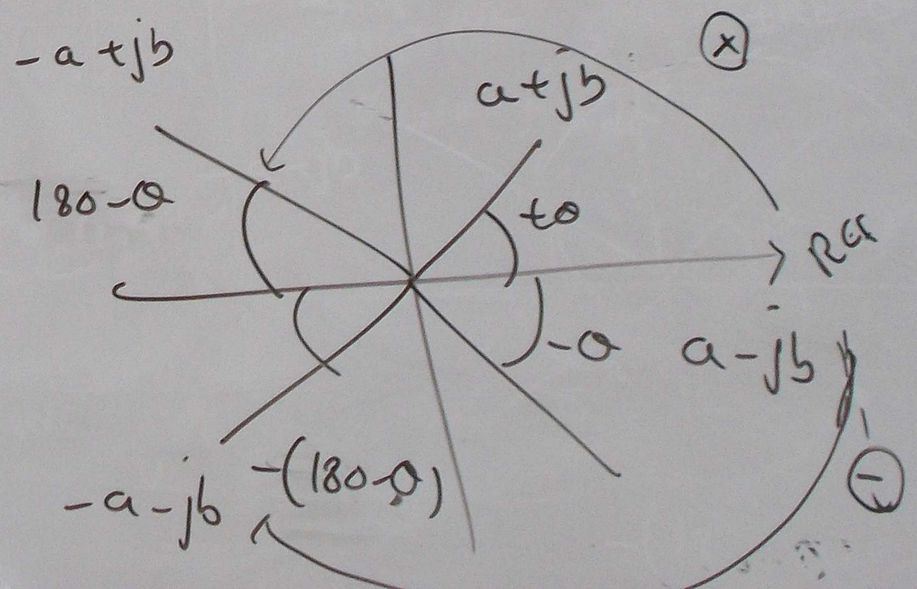
$= 32.6 + j76.2 - [-82.17 - j9.794]$

$= 32.6 + j76.2 + 82.17 + j9.794$

$= 114.77 + j85.994$

$= \sqrt{114.77^2 + 85.994^2} \angle \tan^{-1}\frac{85.994}{114.77}$

$= 143.4\angle 36.8$ Amp



(c)

Δ

PHASE VOLTAGE = LINE VOLTAGE = 415V

(d)

3φ POWER = $I_{AB}^2 R_A + I_{BC}^2 R_B + I_{CA}^2 R_C$

$= 83^2 \times 3 + 83^2 \times 3 + 83^2 \times 3$

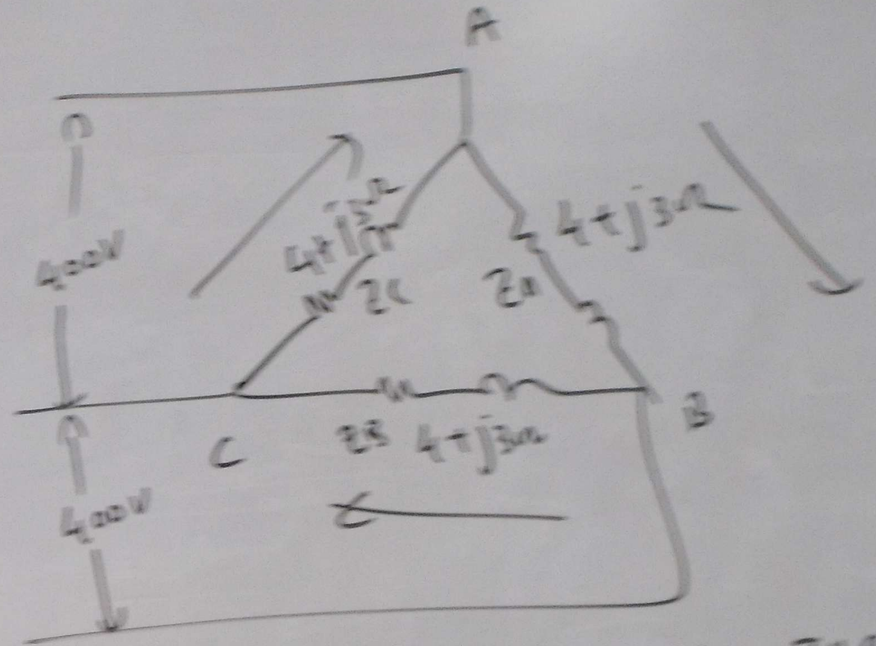
$= 62001$ WATT

(e) 3φ POWER = $\sqrt{3}\, E_{LINE}\, I_{LINE} \times \cos\theta$

$62001 = 1.732 \times 415 \times 143.7 \times \cos\theta$

$\cos\theta = \dfrac{62001}{1.732 \times 415 \times 143.7} = 0.6$

LAGGING



CALCULATE (a) CURRENTS FLOWING THROUGH Z_A, Z_B, Z_C

(b) LINE CURRENTS

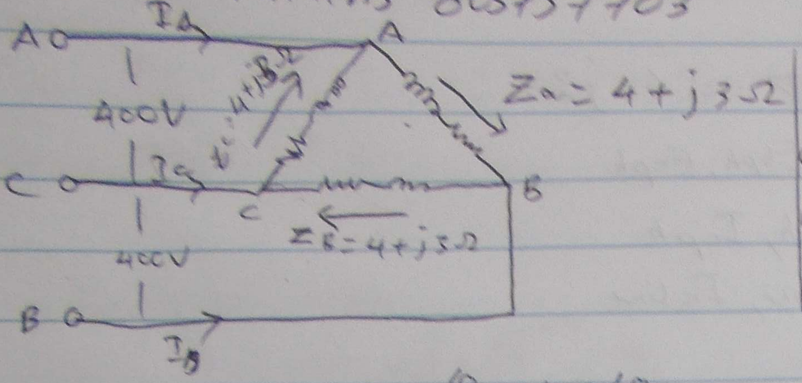
(c) PHASE VOLTAGE

(d) 3φ POWER

(e) POWER FACTOR

AC

ERICK MATIAS 803737703



Calculate:
(a) Current flow to Z_A, Z_B, Z_C
(b) Line current (c) phase voltage
(d) 3φ power (e) power factor

(a) $I_{Za} = \frac{E_{ab}}{Z_a} = \frac{400\angle 0}{4+j3} = \frac{400\angle 0}{5\angle 36.87} = 80\angle -36.87$ A I_{AB}

$I_{Zb} = \frac{E_{BC}}{Z_b} = \frac{400\angle -120}{5\angle 36.87} = 80\angle -156.87$ I_{BC}

$I_{Zc} = \frac{E_{CA}}{Z_c} = \frac{400\angle 120}{5\angle 36.87} = 80\angle 83.13$ I_{CA}

(b) $I_{Line} = \sqrt{3}\, I_{AB} = \sqrt{3}\, I_{AC} = \sqrt{3}\, I_{BC}$ (balanced)

$= \sqrt{3} \cdot 80$

$= 138.56$

Line A

$I_A = I_{AB} - I_{AC} = 80\angle -36.87 - 80\angle -156.87 \angle 83.13$

$= (63.99 - j48) - (-73.57 - j31.42)$ $(9.57 + j79.42)$

$= 137.56 - j16.58$ $54.42 - j127.42$

$= 138.55\angle -6.87$

$I_B = I_{BC} - I_{AB} = 80\angle -156.87 - 80\angle -36.87$

$= (-73.57 - j31.42) - (63.99 - j48)$

$= -137.56 + j16.58$

$= 138.55\angle 173.12$

$I_C = I_{AC} - I_{BC} = 80\angle 83.13 - 80\angle -156.87$

$= (9.57 + j79.42) - (-73.57 - j31.42)$

$= 83.14 + j110.84$

$= 138.55\angle 53.126$

(c) phase voltage = Line voltage = 400V

(d) 3φ power $= I_{AB}^2 \cdot R_a + I_{BC}^2 \cdot R_b + I_{CA}^2 \cdot R_c$

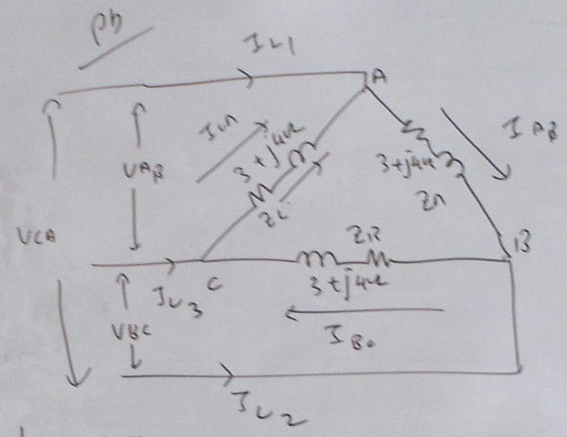
$= (80^2 \cdot 4) \times 3 = 76{,}800$

(e) 3φ power $= \sqrt{3} \cdot I_{Line} \cdot E_{Line} \cdot \cos\theta$

$76{,}800 = \sqrt{3} \cdot 138.56 \times 400 \cdot \cos\theta$

$\cos\theta = \frac{76{,}800}{95{,}907.18} = 0.8$ Lagging

DELTA CONNECTION



LINE VOLTAGE = 415V

IN THE GIVEN CIRCUIT, CALCULATE

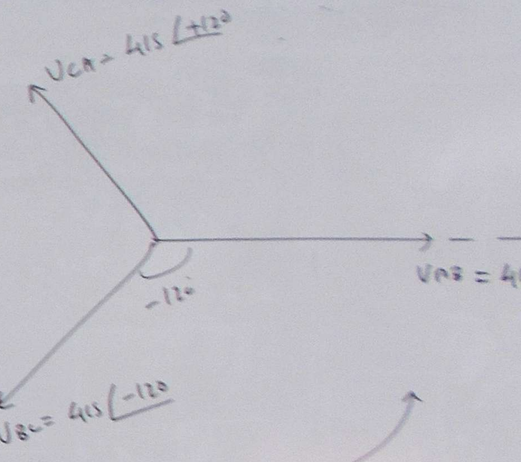
(a) CURRENTS FLOW THROUGH ZA, ZB, ZC

(b) LINE CURRENTS

(c) PHASE VOLTAGES

(d) 3φ POWER

(e) POWER FACTOR

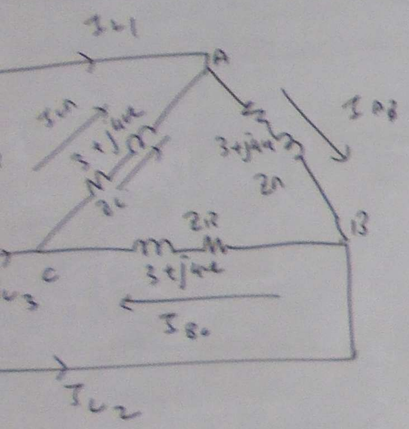


(a) $I_{ZA} = I_{AB} = \frac{V_{AB}}{Z_A} = \frac{415\angle 0}{3+j4} =$

$I_{ZB} = I_{BC} = \frac{V_{BC}}{Z_B} = \frac{415\angle -120}{3+j4}$

$I_{ZC} = I_{CA} = \frac{V_{CA}}{Z_C} = \frac{415\angle 120}{3+j4}$

DELTA CONNECTION



E=415V

N THE GIVEN CIRCUIT, CALCULATE

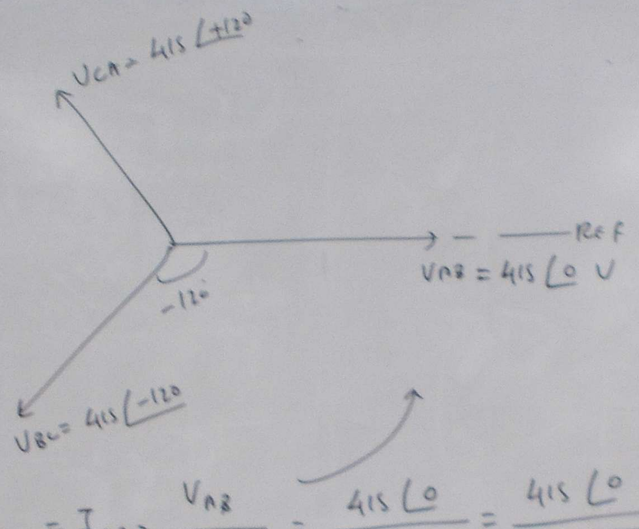
(a) CURRENTS FLOW THROUGH ZA, ZB, ZC

(b) LINE CURRENTS

(c) PHASE VOLTAGES

(d) 3φ POWER

(e) POWER FACTOR



(a) $I_{ZA} = I_{AB} = \frac{V_{AB}}{Z_A} = \frac{415\angle 0}{3+j4} = \frac{415\angle 0}{\sqrt{3^2+4^2}\angle \tan^{-1}4/3} = \frac{415}{5\angle 53.2} = 83\angle -53.2$ AMP

$I_{ZB} = I_{BC} = \frac{V_{BC}}{Z_B} = \frac{415\angle -120}{3+j4} = \frac{415\angle -120}{5\angle 53.2} = 83\angle -173.2$ AMP

$I_{ZC} = I_{CA} = \frac{V_{CA}}{Z_C} = \frac{415\angle 120}{3+j4} = \frac{415\angle 120}{5\angle 53.2} = 83\angle 66.8$ AMP

(b)

METHOD (1) BALANCED (ONLY

$I_L = \sqrt{3}\, I_{AB} = \sqrt{3}\, I_{BC} = \sqrt{3}\, I_{CA}$

$= 1.7321 \times 83 = 143.7$ AMP

METHOD (2) ANY LOAD (

(A) APPLY $I_{L1} + I_{CA} =$

$I_{L1} = I_{AB} -$

$= 83\angle -53.2$

$= 83(\cos 53.2$

$= 49.8 - j66$

$= 17.2 - j$

$= \sqrt{17.2^2 +$

$= 1426$

THONGS,
OPEN SANDALS
AND
CANVAS SHOES
ARE NOT
APPROPRIATE
FOOTWEAR
IN THIS BUILDING

(b)

METHOD (1) BALANCED (ONLY MAGNITUDE)

$I_L = \sqrt{3}\, I_{AB} = \sqrt{3}\, I_{BC} = \sqrt{3}\, I_{CA}$

$= 1.7321 \times 83 = 143.76$ AMP

METHOD (2) ANY LOAD (MAGNITUDE + PHASE ANGLE)

(A) POINT $I_{L_1} + I_{CA} = I_{AB}$

$I_{L_1} = I_{AB} - I_{CA}$

$= 83\angle -53.2 - 83\angle 66.8$

$= 83(\cos 53.2 - j\sin 53.2) - 83(\cos 66.8 + j\sin 66.8)$

$= 49.8 - j66.4 - 32.6 - j76.2$

$= 17.2 - j142.6$

$= \sqrt{17.2^2 + 142.6^2}\ \angle -\tan^{-1}\frac{142.6}{17.2}$

$= 143.6\angle -83.12$ Amp

$\frac{415}{5\angle 53.2} = 83\angle -53.2$ Amp

$\frac{-100}{53.2} = 83\angle -173.2$ Amp

$\frac{10}{53.2} = 83\angle 66.8$ Amp

(B) POINT

$I_{L_2} + I_{AB} = I_{BC}$

$I_{L_2} = I_{BC} - I_{AB}$

$= 83\angle -173.2 - 83\angle -53.2$

$= 83(\cos(-173.2) + j\sin(-173.2)) - [49.8 - j66.4]$

$= 83(-0.99 + (-j0.118)) - 49.8 + j66.4$

$= -82.17 - j9.794 - 49.8 + j66.4$

$I = -131.97 + j56.6$

$= \sqrt{131.97^2 + 56.6^2}\ \angle +(180 - \tan^{-1}\frac{56.6}{131.97}$

$143.59\angle +(180 - 23.1)$

$143.59\angle +156.8$ Amp

C POINT

$I_{L_3} + I_{BC} =$

$I_{L_3} = I_{CA} -$

$= 83\angle 66.8$

$= 32.6 +$

$= 114.7$

$= \sqrt{114.7}$

$= 143$

$-a + jb$

$180 - \theta$

$-a - jb$

ELECTRICAL ENGINEERING PLEASE DO NOT REMOVE

NT

$+ I_{AB} = I_{BC}$

$I_{BC} - I_{AB}$

$83\angle -173.2 - 83\angle -53.2$

$83(\cos(-173.2) + j\sin(-173.2)) - [49.8 - j66.4]$

$83(-0.99 + (-j0.118)) - 49.8 + j66.4$

$-82.17 - j9.794 - 49.8 + j66.4$

$-131.97 + j56.6$

$\sqrt{131.97^2 + 56.6^2} \quad \angle +(180 - \tan^{-1}\frac{56.6}{131.97})$

$143.59 \angle +(180 - 23.1)$

$143.59 \angle +156.3$ Amp

C POINT

$I_{L3} + I_{BC} = I_{CA}$

$I_{L3} = I_{CA} - I_{BC}$

$= 83\angle 66.8 - 83\angle -173.2$

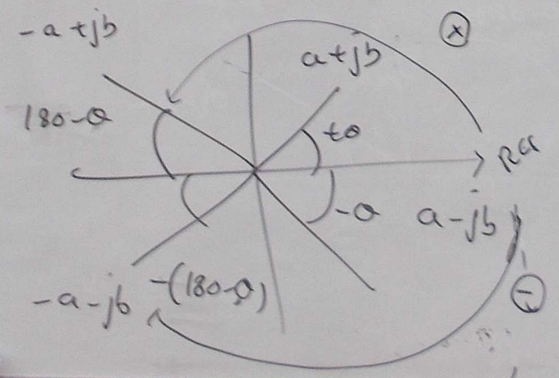
$= 32.6 + j76.2 - [-82.17 - j9.794]$

$= 32.6 + j76.2 + 82.17 + j9.794$

$= 114.77 + j85.994$

$= \sqrt{114.77^2 + 85.994^2} \quad \angle \tan^{-1}\frac{85.994}{114.77}$

$= 143.4 \angle 36.8$ Amp



(c)

PHASE VOLTAGE = LINE VOLTAGE = 415V

(d)

3φ POWER $= I_{AB}^2 R_A + I_{BC}^2 R_B + I_{CA}^2 R_C$

$= 83^2 \times 3 + 83^2 \times 3 + 83^2 \times 3$

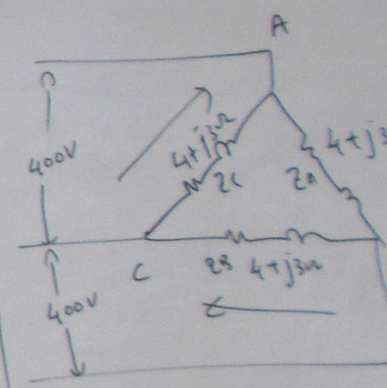
$= 62001$ WATT

(e) 3φ POWER $= \sqrt{3}\, E_{LINE}\, I_{LINE} \times \cos\theta$

$62001 = 1.7321 \times 415 \times 143.76 \cos\theta$

$\cos\theta = \frac{62001}{1.7321 \times 415 \times 143.76} = 0.6$

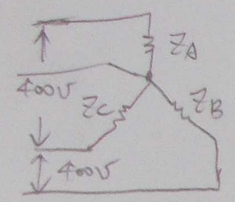
LAGGING



CALCULATE (a) CURRENT
(b) LINE CU
(c) PHASE
(d) 3φ PO
(e) POWER

Archer (HIU) 20378045

$Z_A = Z_B = Z_C = (4+j3)\,\Omega = 5\angle 37^\circ$



(a)
$$\begin{cases} E_{Apn} = \frac{400}{\sqrt{3}} \angle 0^\circ = 230.9\angle 0^\circ \\ E_{Bpn} = 230.9\angle -120^\circ \\ E_{cpn} = 230.9\angle 120^\circ \end{cases} \qquad \begin{cases} E_{AB} = 400\angle 30^\circ \\ E_{BC} = 400\angle -90^\circ \\ E_{CA} = 400\angle 150^\circ \end{cases}$$

(b)
$$\begin{cases} I_{Apn} = \frac{230.9\angle 0^\circ}{5\angle 37^\circ} = 46.18\angle -37^\circ \\ I_{Bpn} = 46.18\angle -157^\circ \\ I_{cpn} = 46.18\angle 83^\circ \end{cases} \#$$

(C)
$$\begin{cases} I_{ALine} = I_{Apn} = 46.18\angle -37^\circ \\ I_{BLine} = I_{Bpn} = 46.18\angle -157^\circ \\ I_{cLine} = I_{cpn} = 46.18\angle 83^\circ \end{cases} \#$$

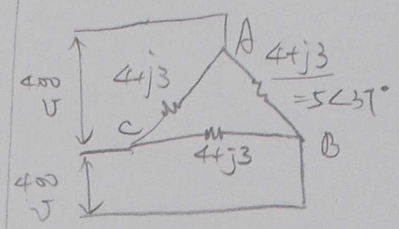
(D) 3φ Power

$P = I^2R = 46.18^2 \times (4)\,\Omega$

$= 8.53\ kW$

$3P = 3 \times 8.53\ kW = 25.6\ kW$ #

△ Connect



(a)
$$\begin{cases} I_{ZA} = I_{AB} = \frac{400\angle 0^\circ}{5\angle 37^\circ} = 80\angle -37^\circ \\ I_{ZB} = I_{BC} = 80\angle -157^\circ \\ I_{ZC} = I_{CA} = 80\angle 83^\circ \end{cases} \#$$

(b) $I_L = \sqrt{3}\, I_{AB} = 138.6$ (Magnitude)

Point A

$I_{L1} + I_{CA} = I_{AB}$

$I_{L1} = I_{AB} - I_{CA}$

$= 80\angle -37^\circ - 80\angle 83^\circ$

$= (63.9 - j48.1) - (9.75 + j79.4)$

$= 54.2 - j127.5 = 138.6\angle 67^\circ$

$$\begin{cases} I_{L1} = 138.6\angle 67^\circ \\ I_{L2} = I_{BC} - I_{AB} = 138.6\angle -53^\circ \\ I_{L3} = I_{CA} - I_{BC} = 138.6\angle 187^\circ \end{cases} \#$$

(c) $V_{Phase} = V_{Line} = 400\ V$ #

$$\begin{cases} 400\angle 0^\circ & A \\ 400\angle -120^\circ & B \\ 400\angle 120^\circ & C \end{cases} \#$$

(d) $3\phi\ Power = 3(4 \times 80^2) = 76.8\ kW$ #

$= I^2R\ (R=4)$

(e) $I_{Line} = I_{Apn} = I_{Bpn} = I_{cpn}$

$= 46.18\ A$

$3\phi\ Power = I_{Line} E_{Line} \times \sqrt{3} \cos\theta$

$\cos\theta = 0.8$ #

(e) $Power\ factor = \frac{3\phi\ Power}{\sqrt{3}\, E_{Line} I_{Line}} = \cos\theta$

$\cos\theta = \frac{76800}{\sqrt{3} \times 400 \times 138.6} = 0.8$ #

Lang Li 80209378|

a) $I_{Z_A} = I_{AB} = \frac{400}{4+j3} = \frac{400}{5\angle \tan^{-1}\frac{3}{4}} = 80\angle -36.87$

$I_{Z_b} = I_{BC} = \frac{400\angle -120}{4+j3} = 80\angle -156.87$

$I_{Zc} = I_{CA} = \frac{400\angle 120}{4+j3} = 80\angle 83.13$

b) $I_L = \sqrt{3}\, I_{AB} = \sqrt{3} I_{BC} = \sqrt{3} I_{CA}$

$= \sqrt{3} \times 80 = 138.56$ A

Ⓐ point $I_{L_1} = I_{AB} - I_{CA}$

$= 80\angle -36.87 - 80\angle 83.13$

$= 54.43 - 127.43j$

$= \sqrt{54.43^2 + 127.43^2}\angle -\tan^{-1}\frac{127.43}{54.43}$

$= 138.57\angle -66.87$

Ⓑ point

$I_{L_2} = I_{BC} - I_{AB}$

$= 80\angle -156.87 - 80\angle -36.87$

$= -137.57 + 16.57j$

$= 138.56\angle 180 - \tan^{-1}\frac{16.57}{137.57}$

$= 138.56\angle 173.13$ A

Ⓒ point

$I_{L_3} = I_{CA} - I_{BC}$

$= 80\angle 83.13 - 80\angle -156.87$

$= 83.14 + 110.9j$

$= 138.6\angle \tan^{-1}\frac{110.9}{83.14}$

$= 138.6\angle 53.14$

d) 3ϕ power

$= 80^2 \times 4 \times 3$

$= 76800$ W

e) 3ϕ power

$76800 = \sqrt{3} \times 400 \times 138.6 \cos\theta$

$\cos\theta = 0.8$

Lagging

c) phase V = Line V = 400V

d) 3ϕ power = $I_{AB}^2 * R_A + I_{BC}^2 \times R_B + I_{CA}^2 \times R_C$

$80^2 \times 4 + 80^2 \times 4 + 80^2 \times 4$

= 76800 watts

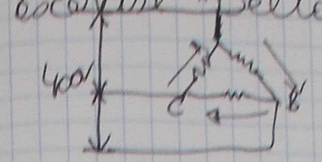
e) 3ϕ power = $\sqrt{3} \times E_{line} \times I_{line} \times \cos\theta$

$76800 = \sqrt{3} \times 400 \times 138.56 \times \cos\theta$

$\cos\theta = \frac{76800}{\sqrt{3} \times 400 \times 138.56} = 0.8$ lagging.

MARCUS G BASEGGIO
8037737657

Esercizio Delta connection



$A = B = C = 4 + 3j$

a) I trought Z_a, Z_b, Z_c
b) line currents
c) phase voltage
d) 3ϕ power
e) power factor.

e) $I_{Za} = I_{AB} = \frac{V_{AB}}{Z_a} = \frac{400\angle 0}{\sqrt{3^2+4^2}\angle \tan^{-1}\frac{3}{4}} = \frac{400\angle 0}{5\angle 36.86} = 80\angle -36.36$

$I_{Zb} = I_{BC} = \frac{V_{BC}}{Z_B} = \frac{400\angle -120}{5\angle 36.86} = 80\angle -83.14°$

$I_{Zc} = I_{CA} = \frac{V_{CA}}{Z_C} = \frac{400\angle -240}{5\angle 36.86} = 80\angle -203.14°$

b) Method ① Balanced (only magnitude) 137.57

$I_L = \sqrt{3} I_{AB} = \sqrt{3} I_{BC} = \sqrt{3} I_{AC}$

$= \sqrt{3} \times 80 = 138.56$

Method ② any load (magnitude and angle)

$I_{AB} = 64 - j48$
$I_{BC} = 9.55 - j79.42$
$I_{CA} = -73.5 + j31.4$

A point $I_{L1} + A_{CA} = I_{AB}$

$I_{L1} = A_{AB} - A_{CA}$

$= 80\angle -36.86 - 80\angle -203.14$

$= 64 - j48 - (-73.5 + j31.4)$

$137.5 - j79.4$

$\sqrt{137.5^2 + 79.42^2}\angle \tan^{-1}\frac{79.4}{137.5}$

$= 158\angle -30$

B point $I_{L2} = I_{BC} - I_{BA}$

$9.55 - j79.42 - 64 - j48)$

$-54.45 - j31$

$\sqrt{54.45^2 + 31^2}\angle \tan^{-1}\frac{31}{54.45}$

$= 62.65\angle -29.65$

C point $I_{L3} = I_{CA} - I_{BC}$

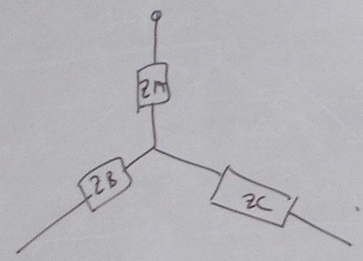
$-73.5 + j31.4 - (9.55 - j79.42)$

$63.95 + j110.82$

$\sqrt{63.95^2 + 110.82^2}\angle \tan^{-1}\frac{110.82}{63.95}$

$= 127.94\angle 60°$

STAR / DELTA CONVERSION

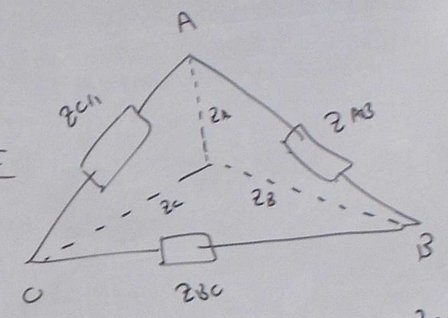


$$Z_{AB} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_C}$$

$$Z_{BC} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_A}$$

$$Z_{CA} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_B}$$

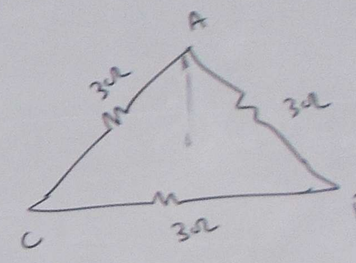
$\equiv$



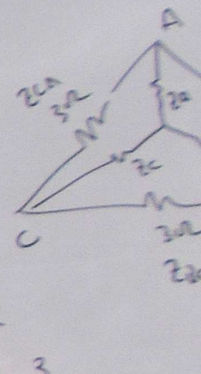
$$Z_A = \frac{Z_{AB} \times Z_{CA}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$Z_B = \frac{Z_{AB} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$Z_C = \frac{Z_{CA} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$



→



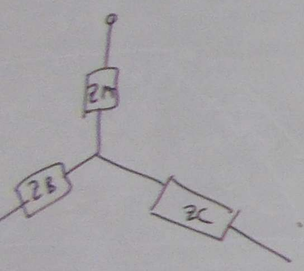
CONVERT IT TO STAR

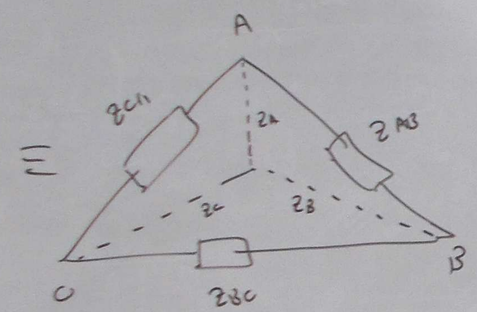
$$Z_A = \frac{3 \times 3}{3 + 3 + 3}$$

$$Z_B = \frac{3 \times 3}{3 + 3 + 3}$$

$$Z_C = \frac{3 \times 3}{3 + 3 + 3} =$$

STAR / DELTA CONVERSION





$$= \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_C}$$

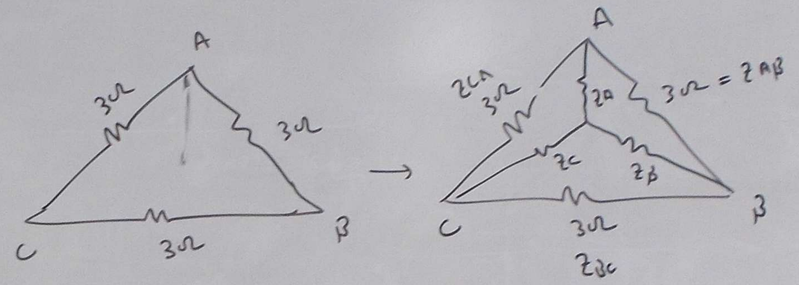
$$C = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_A}$$

$$CA = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_B}$$

$$Z_A = \frac{Z_{AB} \times Z_{CA}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$Z_B = \frac{Z_{AB} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$Z_C = \frac{Z_{CA} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

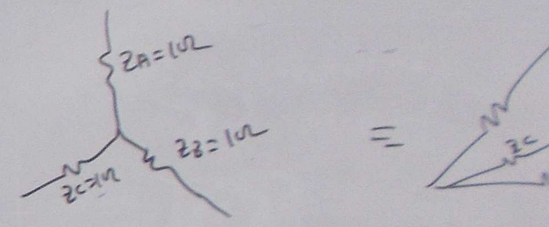


CONVERT IT TO STAR

$$Z_A = \frac{3 \times 3}{3+3+3} = \frac{9}{9} = 1\Omega$$

$$Z_B = \frac{3 \times 3}{3+3+3} = 1\Omega$$

$$Z_C = \frac{3 \times 3}{3+3+3} = 1\Omega$$



CONVERT TO DELTA

$$Z_{AB} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_C}$$

$$= \frac{1\times1 + 1\times1 + 1\times1}{1}$$

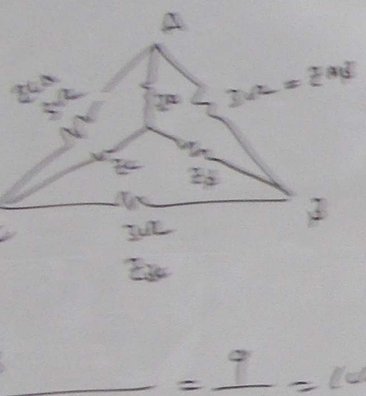
$$= \frac{3}{1}$$

$$Z_{BC} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_A}$$

$$= \frac{1\times1 + 1\times1 + 1\times1}{1}$$

$$Z_{CA} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_B}$$





$$= \frac{9}{9} = 1\Omega$$

$$= 1\Omega$$

$$= 1\Omega$$



CONVERT TO DELTA

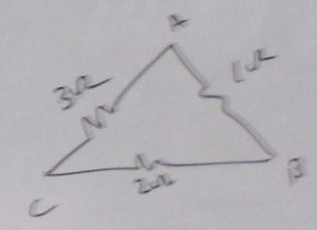
$$Z_{AB} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_C} = \frac{1\times1 + 1\times1 + 1\times1}{1} = \frac{3}{1} = 3\Omega$$

$$Z_{BC} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_A} = \frac{1\times1 + 1\times1 + 1\times1}{1} = 3\Omega$$

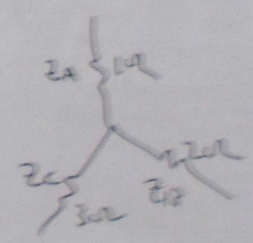
$$Z_{CA} = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_B} = \frac{1\times1 + 1\times1 + 1\times1}{1} = 3\Omega$$

EXERCISE

CONVERT IT TO STAR

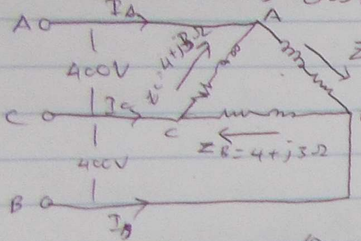


CONVERT IT TO DELTA



AC

ERICK MATIAS 803737703



Calculate:
(a) current flow to Z_A, Z_B, Z_C
(b) Line current (c) phase voltage
(d) 3ϕ power (e) power factor

(a) $I_{Za} = \frac{E_{ab}}{Z_a} = \frac{400\angle 0}{4+j3} = \frac{400\angle 0}{5\angle 36.87} = 80\angle -36.87$ A I_{AB}

$I_{Zb} = \frac{E_{BC}}{Z_b} = \frac{400\angle -120}{5\angle 36.87} = 80\angle -156.87$ I_{BC}

$I_{Zc} = \frac{E_{CA}}{Z_c} = \frac{400\angle 120}{5\angle 36.87} = 80\angle 83.13$ I_{CA}

(b) $I_{Line} = \sqrt{3}\, I_{AB} = \sqrt{3}\, I_{AC} = \sqrt{3}\, I_{BC}$ (balanced)
$= \sqrt{3} \cdot 80$
$= 138.56$

Line A

$I_A = I_{AB} - I_{AC} = 80\angle -36.87 - 80\angle -156.87 \angle 83.13$
$= (63.99 - j48) - (-73.57 - j31.42)$ $(9.57 + j79.42)$
$= 137.56 - j16.58$ $54.42 - j127.42$
$= 138.55\angle -6.87$

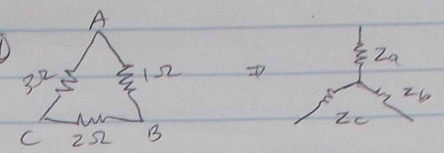
$I_B = I_{BC} - I_{AB} = 80\angle -156.87 - 80\angle -36.87$
$= (-73.57 - j31.42) - (63.99 - j48)$
$= -137.56 + j16.58$
$= 138.55\angle 173.12$

$I_C = I_{AC} - I_{BC} = 80\angle 83.13 - 80\angle -156.87$
$= (9.57 + j79.42) - (-73.57 - j31.42)$
$= 83.14 + j110.84$
$= 138.55\angle 53.126$

(c) phase voltage = Line voltage = 400V

(d) 3ϕ power $= I_{AB}^2 \cdot R_a + I_{BC}^2 \cdot R_b + I_{CA}^2 \cdot R_c$
$= (80^2 \cdot 4) \times 3 = 76{,}800$

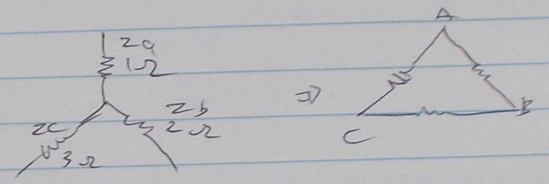
(e) 3ϕ power $= \sqrt{3} \cdot I_{Line} \cdot E_{Line} \cdot \cos\theta$
$76{,}800 = \sqrt{3} \cdot 138.56 \times 400 \cdot \cos\theta$
$\cos\theta = \frac{76800}{95907.18} = 0.8$ Lagging

① 

$Z_a = \frac{Z_{ab} \times Z_{ca}}{Z_{ab} + Z_{bc} + Z_{ca}}$
$= \frac{1 \times 3}{1+2+3} = \frac{3}{6} = 0.5\Omega$

$Z_b = \frac{Z_{AB} \times Z_{BC}}{Z_{ab} + Z_{bc} + Z_{ca}} = \frac{1 \times 2}{6} = \frac{2}{6} = 0.33\Omega$

$Z_c = \frac{3\Omega \times 2\Omega}{6\Omega} = \frac{6}{6} = 1\Omega$

② 

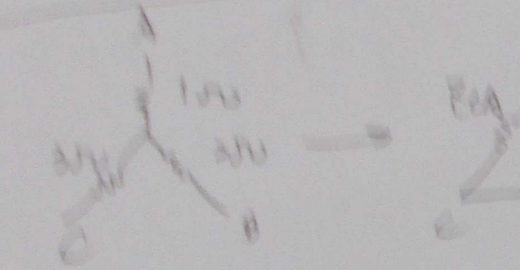
$Z_{AB} = \frac{Z_a \cdot Z_b + Z_b \cdot Z_c + Z_c \cdot Z_a}{Z_c}$
$= \frac{1\times 2 + 2\times 3 + 3\times 1}{3}$
$= \frac{2+6+3}{3} = \frac{11}{3} = 3.67\Omega$

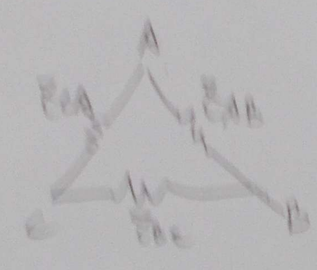
$Z_{BC} = \frac{Z_a \cdot Z_b + Z_b Z_c + Z_c \cdot Z_a}{Z_a}$
$= \frac{11}{1} = 11\Omega$

$Z_{CA} = \frac{11}{2} = 5.5\Omega$



$$\begin{cases} E_A = \dfrac{12}{6} = 2\ V \\ E_B = \dfrac{6}{6} = 1\ V \\ E_C = \dfrac{12}{6} = \dfrac{1}{3}\ V \end{cases}$$





$$\begin{cases} E_{AB} = \dfrac{(1\times4+3\times3)+3\times1}{3} = \dfrac{11}{3}\ (V) \\ E_{BC} = \dfrac{11}{3}\ (V) \\ E_{CA} = 11\ (V) \end{cases}$$

a)

$$Z_A = \frac{Z_{AB} \times Z_{CA}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{1 \times 3}{1+2+3} = \frac{3}{6} = 0.5\,\Omega$$

$$Z_B = \frac{1 \times 2}{1+2+3} = \frac{2}{6} = 0.3\,\Omega$$

$$Z_C = \frac{3 \times 2}{1+2+3} = \frac{6}{6} = 1\,\Omega$$

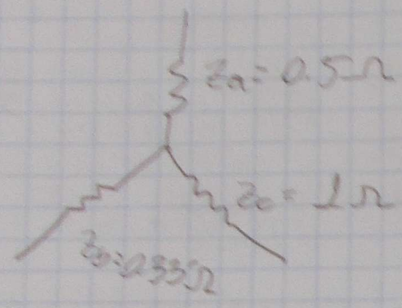
b) $$Z_{AB} = \frac{3\times2 + 3\times1 + 1\times2}{3}$$

$$= \frac{6+3+2}{3} = \frac{11}{3}\,\Omega$$

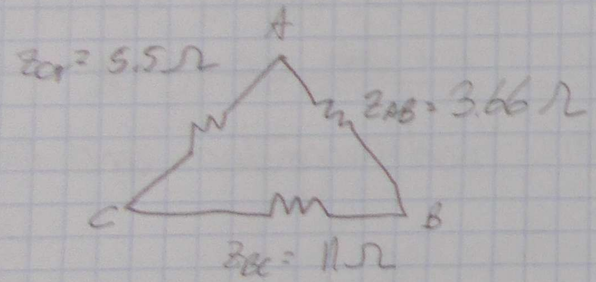
$$Z_{AC} = \frac{11}{2}\,\Omega$$

$$Z_{BC} = \frac{11}{1} = 11\,\Omega$$

Lang Li 8020937881

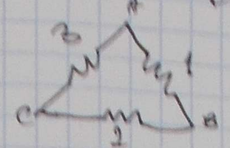


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Star/Delta conversion

Exercise convert to star

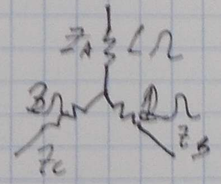


$$Z_a = \frac{Z_{ab} \times Z_{ca}}{Z_{AB} + Z_{BC} + Z_{CA}} = \frac{1 \times 3}{1+2+3} = \frac{3}{6} = 0.5\Omega$$

$$Z_b = \frac{Z_{AB} \times Z_{BC}}{\Delta Z} = \frac{1 \times 2}{6} = \frac{2}{6} = 0.333\Omega$$

$$Z_c = \frac{Z_{BC} \times Z_{AC}}{\Delta Z} = \frac{2 \times 3}{6} = \frac{6}{6} = 1\Omega$$

Convert it to delta



$$Z_{AB} = \frac{Z_A \times Z_B + Z_B \times Z_C + Z_C \times Z_A}{Z_C}$$

$$Z_{AB} = \frac{1 \times 2 + 2 \times 3 + 3 \times 1}{3} = \frac{11}{3} = 3.66\Omega$$

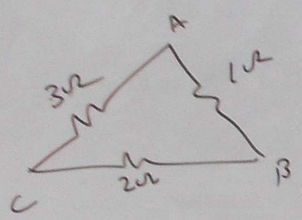
$$Z_{BC} = \frac{\Delta Z}{Z_A} = \frac{11}{1} = 11\Omega$$

$$Z_{CA} = \frac{\Delta Z}{Z_B} = \frac{11}{2} = 5.5\Omega$$

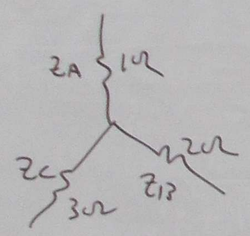
AND
CANVAS SHOES
ARE NOT
APPROPRIATE
FOOTWEAR
IN THIS BUILDING

EXERCISE

CONVERT IT TO STAR



CONVERT IT TO DELTA

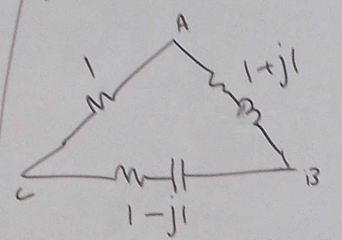


Ω

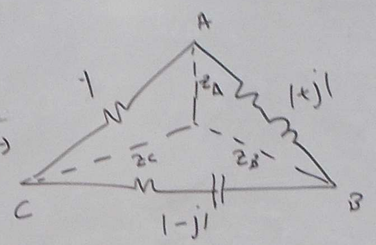
$= \frac{1\times1 + 1\times1 + 1\times1}{1}$

$= 3\Omega$

Ex



$\rightarrow$



CONVERT TO STAR

$$Z_A = \frac{Z_{CA} \times Z_{AB}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{1\angle 0 \times (1+j1)}{1+j1+(1-j1)+1}$$

$$= \frac{1\angle 0 \times \sqrt{1^2+1^2}\angle \tan^{-1}1/1}{3}$$

$$= \frac{1\angle 0 \times 1.4142\angle 45}{3\angle 0}$$

$$= 0.6\angle 45\ \Omega$$

$$Z_B = \frac{Z_{AB} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{(1+j1) \times (1-j1)}{3}$$

$$= \frac{1.4142\angle 45 \times 1.4142\angle -45}{3}$$

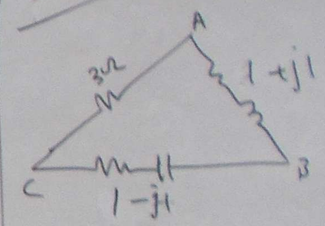
$$= \frac{2}{3} = 0.666\ \Omega$$

$$Z_C = \frac{Z_{CA} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{1\times(1-j1)}{3} = \frac{1\angle 0 \times 1.4142\angle -45}{3}$$

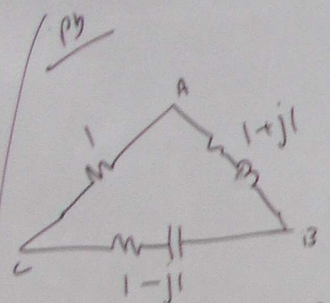
$$= 0.6\angle -45\ \Omega$$

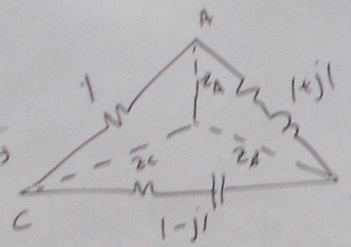
EXERCISE



CONVERT IT TO STAR

STAR





CONVERT TO STAR

$$Z_A = \frac{Z_{CA} \times Z_{AB}}{Z_{AB}+Z_{BC}+Z_{CA}}$$

$$= \frac{1\angle 0 \times (1+j1)}{1+j1+(1-j1)+1}$$

$$= \frac{1\angle 0 \times \sqrt{1^2+1^2}\angle \tan^{-1}1/1}{3}$$

$$= \frac{1\angle 0 \times 1.4142\angle 45}{3\angle 0}$$

$$= 0.6\angle 45\ \Omega$$

$$Z_B = \frac{Z_{AB} \times Z_{BC}}{Z_{AB}+Z_{BC}+Z_{CA}}$$

$$= \frac{(1+j1) \times (1-j1)}{3}$$

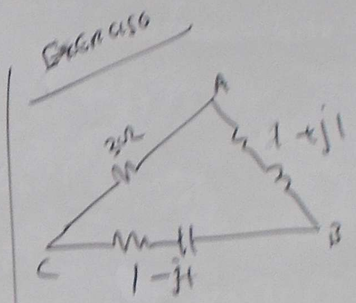
$$= \frac{1.4142\angle 45 \times 1.4142\angle -45}{3}$$

$$= \frac{2}{3} = 0.666\ \Omega$$

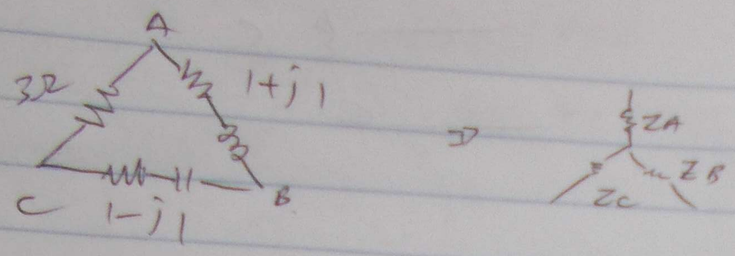
$$Z_C = \frac{Z_{CA} \times Z_{BC}}{Z_{AB}+Z_{BC}+Z_{CA}}$$

$$= \frac{1 \times (1-j1)}{3} = \frac{1\angle 0 \times 1.4142\angle -45}{3}$$

$$= 0.6\angle -45\ \Omega$$



CONVERT IT TO STAR



$$Z_a = \frac{Z_{AB} \times Z_{AC}}{Z_{ab} + Z_{bc} + Z_{ca}}$$

$$= \frac{1+j1 \times 3}{(1+j1)+(1-j1)+3}$$

$$= \frac{1.41 \angle 45 \times 3 \angle 0}{5 + j0}$$

$$= \frac{4.23 \angle 45}{5 \angle 0} = 0.846 \angle 45$$

$$Z_b = \frac{Z_{ab} \times Z_{bc}}{Z_t}$$

$$= \frac{(1+j1) \times (1-j1)}{5 \angle 0}$$

$$= \frac{1.4 \angle 45 \times 1.4 \angle -45}{5 \angle 0}$$

$$= \frac{1.96 \angle 0}{5 \angle 0} = 0.39 \angle 0$$

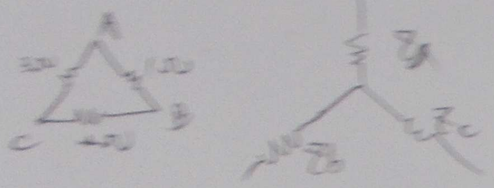
$$Z_c = \frac{Z_{AC} \times Z_{BC}}{Z_t}$$

$$= \frac{3 \angle 0 \times 1.4 \angle -45}{5 \angle 0}$$

$$= \frac{4.2 \angle -45}{5 \angle 0}$$

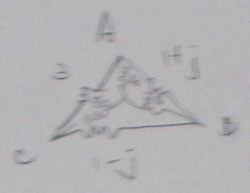
$$= 0.84 \angle -45$$

Archer CH2U
20378045



Δ → Y

$$\begin{cases} Z_A = \dfrac{1\times3}{6} = 2\ \Omega \\ Z_B = \dfrac{3\times2}{6} = 1\ \Omega \\ Z_C = \dfrac{1\times2}{6} = \dfrac{1}{3}\ \Omega \end{cases}$$

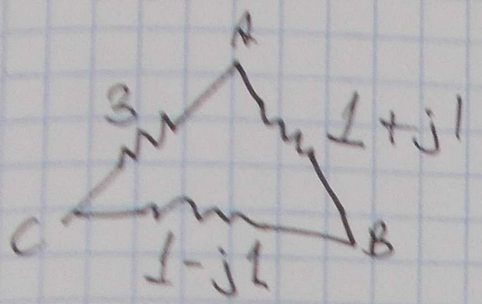


$$\begin{cases} Z_A = \dfrac{3(1+j)}{3+(1-j)+(1+j)} = \dfrac{3}{5}(1+j) \\ Z_B = \dfrac{1}{5}(1+1) = \dfrac{2}{5} \\ Z_C = \dfrac{3}{5}(1-j) = \dfrac{3}{5}(1-j) \end{cases} \quad (\Omega)$$



$$\begin{cases} Z_{AB} = \dfrac{1\times1+2\times3+3\times1}{3} = \dfrac{11}{3}\ (\Omega) \\ Z_{BC} = \dfrac{11}{2}\ (\Omega) \\ Z_{CA} = 11\ (\Omega) \end{cases}$$

Exercise



convert it to star.

$$Z_a = \frac{Z_{CA} \times Z_{AB}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$Z_a = \frac{3\angle 0 \times (1+j1)}{1+j1+1-j1+3} = \frac{3\angle 0 \times \sqrt{1^2+1^2}\angle \tan^{-1}\frac{1}{1}}{5}$$

$$Z_b = \frac{3\angle 0 \times 1.4142\angle 45}{5\angle 0} = \frac{4.2426\angle 45}{5\angle 0} = \boxed{0.88\angle 45}$$

$$Z_b = \frac{1+j1 \times 1-j1}{5\angle 0} = \frac{2}{5} = \boxed{0.4\ \Omega}$$

$$Z_c = \frac{3 \times 1-j1}{5\angle 0} = \frac{3 \times \sqrt{1^2+1^2}\angle \tan^{-1}\frac{1}{1}}{5\angle 0} = \frac{3 \times 1.4142\angle -45}{5\angle 0}$$

$$= \boxed{0.88\angle -45}$$

MATEUS G - 803737657

$$Z_A = \frac{Z_{CA} \times Z_{AB}}{Z_{AB}+Z_{BC}+Z_{CA}} = \frac{3 \times (1+j1)}{3+1+j+1-j} = \frac{3+3j}{5} = 0.6+0.6j$$

$$= 0.85\angle 45$$

$$Z_B = \frac{(1+j1) \times (1-j1)}{5} = 0.4\,\Omega$$

$$Z_C = \frac{3 \times (1-j)}{5} = 0.6-0.6j$$

$$= 0.85\angle -45$$

Lag 4 802437781

$$Z_B = \frac{Z_{AB} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{(1+j1) \times (1-j1)}{3}$$

$$= \frac{1.442\angle 45 \times 1.4142\angle -45}{3}$$

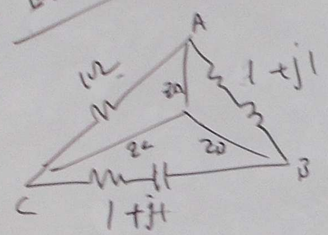
$$= \frac{2}{3} = 0.666\,\Omega$$

$$Z_C = \frac{Z_{CA} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{1 \times (1-j1)}{3} = \frac{1.6 \times 1.4142\angle -45}{3}$$

$$= 0.6\angle -45\,\Omega$$

EXAMPLE



CONVERT IT TO STAR

$$Z_A = \frac{Z_{CA} \times Z_{AB}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{1 \times (1+j1)}{1+j1+1+j1+1}$$

$$= \frac{1.6 \times 1.4142\angle 45}{3+j2}$$

$$= \frac{1.4142\angle 45}{\sqrt{3^2+2^2}\angle \tan^{-1}2/3}$$

$$= \frac{1.4142\angle 45}{3.6\angle 33.6} = 0.392\angle 45-33.6$$

$$= 0.392\angle 11.4\,\Omega$$

$$Z_B = \frac{Z_{AB} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{(1+j1)\ (1+j1)}{3.6\angle 33.6}$$

$$= \frac{1.4142\angle 45 \times 1.4142\angle 45}{3.6\angle 33.6}$$

$$= \frac{2\angle 90}{3.6\angle 33.6}$$

$$= 0.555\angle 56.4\cdot\,\Omega$$

$$Z_C = \frac{Z_{CA} \times Z_{BC}}{Z_{AB} + Z_{BC} + Z_{CA}}$$

$$= \frac{1 \times (1+j1)}{3.6\angle 33.6}$$

$$= \frac{1.4142\angle 45}{3.6\angle 33.6}$$

$$= 0.392\angle 11.4\,\Omega$$

$= \text{TURN RATIO} = \dfrac{\text{PRIMARY TURNS}}{\text{SECONDARY TURNS}}$

$= a = \dfrac{N_P}{N_S}$

$= \text{OUT POWER}$

$= E_S I_S$

$$\frac{I_S}{I_P} = \frac{N_P}{N_S} = a$$

RANSFORMER $E_P = 400V$, $E_S = 200V$

400 TURNS

a) TURN RATIO

(b) SECONDARY TURNS

(c) PRIMARY CURRENT

(d) SECONDARY CURRENT

(a) $a = \dfrac{E_P}{E_S} = \dfrac{400}{200} = 2$

(b) $\dfrac{N_P}{N_S} = a \longrightarrow \dfrac{400}{N_S} = 2 \longrightarrow N_S = \dfrac{400}{2} = 200 \text{ TURNS}$

(c) $I_P = \dfrac{VA}{E_P} = \dfrac{3 \times 10^3}{400} = \dfrac{3000}{400} = 7.5A$

(d) $I_S = \dfrac{VA}{E_S} = \dfrac{3000}{200} = 15A.$

EXERCISE

4 KVA TRANSFORMER, $E_P = 1000V$, $E_S = 500V$

$N_P = 500$ TURNS

CALCULATE (a) TURN RATIO

(b) SECONDARY TURNS

(c) PRIMARY CURRENT

(d) SECONDARY CURRENT

1) 4 kV transformer $E_p = 1000\,V$ $E_s = 500\,V$
$N_p = 500$ turns

calculate a) turn ratio
b) secondary turns
c) primary current
d) secondary current

Nikolche
Petrovski
ID: 802896263

a) $a = \frac{E_p}{E_s} = \frac{1000}{500} = 2$

b) $\frac{N_p}{N_s} = a \rightarrow \frac{500}{N_s} = 2$ $N_s = 250$ turns

c) $I_p = \frac{V_A}{E_p} = \frac{4 \cdot 10^3}{1000} = 4\,A$

d) $I_s = \frac{V_A}{E_s} = \frac{4 \cdot 10^3}{500} = 8\,A$

A. C

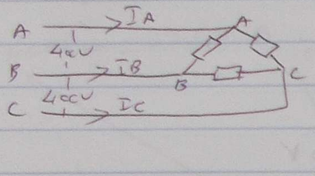
ERICK MATIAS 803737703

$E_{AB} = 400\ V \angle 0$ △ R = 10Ω/phase

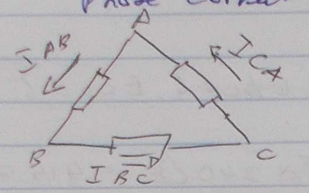
$E_{BC} = 400\ V \angle -120$

$E_{CA} = 400\ V \angle -240$

Line Current



Phase Current



@

$I_{AB} = \frac{E_{AB}}{Z_{AB}} = \frac{400 \angle 0}{10 \angle 0} = 40 \angle 0 A$

$I_{BC} = \frac{E_{BC}}{Z_{BC}} = \frac{400 \angle -120}{10 \angle 0} = 40 \angle -120 A$

$I_{CA} = \frac{E_{CA}}{Z_{CA}} = \frac{400 \angle -240}{100 \angle 0} = 40 \angle -240 A$

~~$I_A = I_{CA}$~~ $I_A + I_{CA} = I_{AB}$

$I_A = I_{AB} - I_{CA}$

$= 40 \angle 0 - 40 \angle -240$

$= 40 + j0 - (-20 + j34.64)$

$= 40 + j0 + 20 - j34.64$

$= 60 - j34.64$

$= 69.28 \angle -30°$

$I_B = I_{BC} - I_{AB}$

$= 40 \angle -120 - 40 \angle 0$

$= -20 - j34.64 - 40$

$= -60 - j34.64$

$= 69.28 \angle -150$

$I_C = I_{CA} - I_{BC}$

$= 40 \angle -240 - 40 \angle -120$

$= -20 + j34.64 - (-20 - j34.64)$

$= -20 + j34.64 + 20 + j34.64$

$= 0 + j69.28$

$= 69.28 \angle 90$

ELECTROMAGNETISM

ERICK MATIAS 803737703

1] An Armature 0.7 m diameter of 8 poles. Lap wound Commutator has 400 Conductors Carries 700 Amp. And has a pole Arc 0.2 m. Calculate Cross magnetizing reaction Amp-turns

D = 0.7 m, p = 8, Z = 400, I_a = 700A, pole Arc = 0.2m

$r = \frac{\text{pole Arc}}{\text{pole pitch}} = \frac{0.2}{\frac{\pi \times D}{P}} = \frac{0.2}{\frac{\pi \cdot 0.7}{8}} = 0.727$

Cross magnetizing flux (armature reaction) $= \frac{r \cdot Z \cdot I_a}{2ap}$; $a = n \times p$ $= 1 \times 8 = 8$

$= \frac{0.727 \cdot 400 \cdot 700}{2 \cdot 8 \cdot 8}$

$= 1590.31$ Amp Turn / pole

2] Brush D = 0.5m, p = 8, Z = 400, I_a = 900 Amp, Shifted = 0.64m

$\beta = \frac{\text{Shifting Circumferential distance}}{\pi \cdot D} \times 360$

$= \frac{0.64m}{\pi\ 0.5m} \times 360 = 9.16$

$a = n \times p = 1 \times 8 = 8$

$AT_\alpha = \frac{\beta \cdot Z \cdot I_a}{360 \cdot a} = \frac{9.16 \times 400 \times 900}{360 \times 8} = 1145$ AT/pole

$AT_c = \frac{Z \cdot I_a}{2p} \left[\frac{360 - 2p\beta}{720}\right]$

$= \frac{400 \times 900}{2 \times 8} \left[\frac{360 - 2 \times 8 \times 9.16}{720}\right]$

$= 22500 [0.2964]$

$= 6670$ AT/pole

$a = \frac{1 \times 8}{a = 8}$

② $AT_d = \frac{B \, z \, I_a}{360 a} = \frac{9.16 \times 400 \times 900}{360 \times 8} = 1145 \text{ amp-turn/pole}$

$\beta = \frac{\text{displacement}}{\tilde{\pi} \times D} \times 360 = \frac{0.04}{\tilde{\pi} \times 0.5} \times 360 = 9.16$

$AT_c = \frac{z I_a}{2p} \left[\frac{360 - 2\beta}{720}\right] = \frac{400 \times 900}{2 \times 8} \left[\frac{360 - 2 \times 8 \times 9.16}{720}\right]$

$AT_c = 6670 \text{ AT/pole}$

NARTEDS & BASEGGIO
8037337657

Exercise

① An armature 0.7 m diameter of 8 poles lap wound commutator has 400 conductors carries 700 Amp and has a pole arc of 0.2 m. Calculate magnetizing armature reaction amp-turn.

$r = \frac{\text{pole arc}}{\text{pole pitch}} = \frac{0.2}{0.274}$ $\quad r = 0.72$

$\text{pole pitch} = \frac{\tilde{\pi} \times D}{\text{n° of poles}} = \frac{\tilde{\pi} \times 0.7}{8} = 0.274$

$a = \frac{n \cdot P}{1 \text{ or } B}$
$a = 8$

$ATC = \frac{r \, z \, I_a}{2 a P} = \frac{0.72 \times 400 \times 700}{2 \times 8 \times 8}$

$ATC = 1575 \text{ Amp/turn/pole}$

② The brushes on a 0.5 m diameter commutator are shifted 0.04 m, the machine has 8 poles (simplex) lap wound 400 conductors, 900 amp armature current. Calculate cross magnetizing and demagnetizing amp-turn/pole.

Lang Li
8029378|

② $\beta = \frac{0.04}{3.1416 \times 0.15} \times 360 = 9.167$

$a = m \times p = 1 \times 8 = 8$

$A_{Ta} = \frac{\beta z I_a}{360 a} = \frac{9.167 \times 400 \times 900}{360 \times 8} = 1146$ AT/pole

$A_{Tc} = \frac{400 \times 900}{2 \times 8} \left[\frac{360 - 2 \times 8 \times 9.167}{720} \right]$

$= 22500 \times 0.2962 = 6667$ AT/pole

① $\gamma = \frac{0.2}{\frac{\pi \times D}{\text{No of poles}}} = \frac{0.2}{\frac{3.14 \times 0.7}{8}} = 0.73$

$a = m \times p$
$= 1 \times 8$
$= 8$

$\Rightarrow \frac{\gamma z I_a}{2 a p} = \frac{0.73 \times 400 \times 70}{2 \times 8 \times 8} = 1597$ A/turn/pole

Exercise

Calculate EDDY current and hysteresis loss

Ke - 4 Kh = 2 f = 50Hz
thickness = 0.5mm
Flux density = 1.0T
Volume = $8m^3$
Core mass = 40kg.

MATERIALS 6B0866000
803237657

$P_h = K_h f B^{1.6} m = 2 \times 50 \times 10^{1.6} \times 40 = 1159.29$ Kilo

$P_e = K_e f^2 t^2 B^2 V = 4 \times (50)^2 \times (0.5 \times 10^{-3})^2 \times 10^2 \times 8$ = 2 watt

ELECTROMAGNETISM

ERICK MATIAS

1] $k_e = 4$, $k_n = 2$, $f = 50\,Hz$, $t = 0.5\,mm$ ↓ $= 0.5 \times 10^{-3} m$, $B = 10\,T$, $V = 8\,m^3$, $m = 40\,kg$.

Hysteresis Lose

$P_n = K_n \cdot f \cdot B^{1.6} \cdot m$

$= 2 \cdot 50 \cdot 10^{1.6} \cdot 40$

$= 159242.86\,Watt$

$= 159.24\,kW$

Eddy Current Lose

$P_e = K_e f^2 \cdot t^2 \cdot B^2 \cdot V$

$= 4 \cdot 50^2 \cdot (0.5 \times 10^{-3})^2 10^2 \cdot 8$

$= 2\,watt$

Unit 3 ES
802295161

Exercise 1

$P_h = K_h f B^n$

$= 2 \times 50 \times 10^{46} \times 40$

$= 159262.9$ watt

$= 159.24$ kwatt.

$P_e = K_e f^2 \cdot t^2 \cdot B^2 V$

$= 4 \times (50)^2 \times (0.5 \times 10^{-3})^2 \times 10^2 \times 8$

$= 2$ watt

$$P_h = K_h \cdot f \cdot B$$

$$= 2 \times 50 \times 10^{1.6} \times 40$$

$$= 100 \times 39.8 \times 40$$

$$= 159240 \text{ kw}$$

$$P_e = K_e f^2 \times t^2 \times B^2 \times V$$

$$= 4 \times 50^2 \times (0.5 \times 10^{-3})^2 \times 10^2 \times 8$$

$$= 2$$

Lang Li

802-93781

Umut SED
802255161

Exercise 1)

$P_h = B^{1.6} M$

$= 2 \times 50 \times 10^{1.6} \times 40$

$= 159242.9$ watt

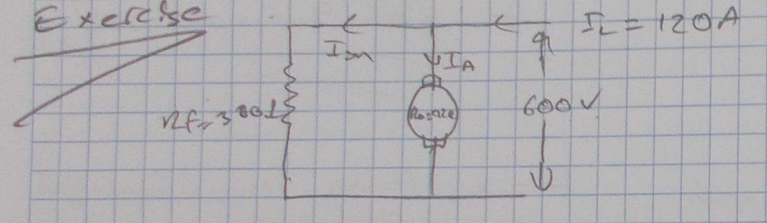
$= 159.24$ kwatt.

$P_e = K_f^2 \cdot t^2 \cdot B^2 \cdot U$

$= 4 \times (50)^2 \times (0.5 \times 10^{-3})^2 \times 10^2 \times 8$

$= 2$ watt

Exercise



Umut SED
80 2255161

$I_{sh} = \frac{600}{R_f} = \frac{600}{300} = 2$ A

$I_a = I_L - I_{sh} = 120 - 2 = 118$ A.

Total copper losser $= I_a^2 R_a + I_{sh}^2 R_{sh}$.

$= 118^2 . 0.2 + 2^2 . 300$

$= 3984.8$ W

Total losser = copper losser + Rotational losser.

$= 3984.8 + 1500$

$= 5484.8$ W

Input power $= V_t . I_L$

$= 600 \times 120$

$= 72000$

Out put power = Input power − losser

$= 72000 - 5484.8$

$= 66515.2$

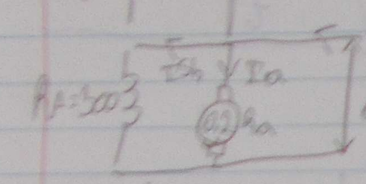
$\text{Efficiency} = \frac{\text{Out put power}}{\text{Input power}} \times 100$

$= \frac{66515.2}{72000} . 100$

$= \%92.4$

5mm Squares

input power = $V_t \times I_L$



$I_{sh} = \frac{600}{R_A} = \frac{600}{300} = 2A$

$I_a = I_L - I_{sh} = 120 - 2 = 118A$

total copper loss = $I_a^2 R_a + I_{sh}^2 R_{sh}$ = $118^2 \times 0.2 + 2^2 \times 300$ = 3.984Kw

total loses = copper loses + rotational loses

3984 + 1500

5484w

input power = $V_t \times I_L$ = 72000

600 × 120

output power = input power − loses

72000 − 5484

66516w

efficiency = $\frac{\text{output power}}{\text{input power}} \times 100$

$\frac{66516}{72000} \times 100$ = 92.38%

MATEUS G BAGGIO
8037376577

Exercise

Calculate Eddy current and hysteresis loss

Ke = 4 Kh = 2 f = 50Hz
thickness = 0.5mm
Flux density = 1T
Volume = $8m^3$
core mass = 40kg.

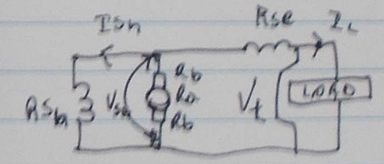
MATEUS G BAGGIO
8037376577

$P_h = K_h f B^{1.6} m = 2 \times 50 \times 10^{1.6} \times 40$ = 159.29 Kw

$P_e = K_e f^2 t^2 B^2 V = 4 \times (50)^2 \times (0.5 \times 10^{-3})^2 \times 10^3 \times 8$ = 2 watt

Copper loss - Variable loss. - DC generator

Short shunt compound



$I_a = I_L + I_{sh}$
$V_{sh} = V_t + I_L \times R_{se}$
$I_{sh} = \frac{V_{sh}}{R_{sh}}$

total copper loss = $I_{Rh}^2 \times R_{sh} + I_L^2 R_{se} + I_a^2 R_a + 2 I_a^2 R_b$

Exercise The winding resistance of 600V, 60Kw DC shunt motor are $R_a = 0.2\Omega$, $R_f = 300\Omega$ rotational losses are 1.5Kw. input current is 120A find efficiency.

ELECTROMAGNETISM

ERICK MATIAS

1) $K_e = 4$, $K_h = 2$, $f = 50\,Hz$, $t = 0.5\,mm$, $B = 1\,T$, $V = 8\,m^3$

$m = 40\,kg$.

$= 0.5 \times 10^{-3}\,m$

Hysteresis Lose

$P_h = K_h \cdot f \cdot B^{1.6} \cdot m$

$= 2 \cdot 50 \cdot 10^{1.6} \cdot 40$

$= 159242.86\,Watt$

$= 159.24\,kW$

Eddy Current Lose

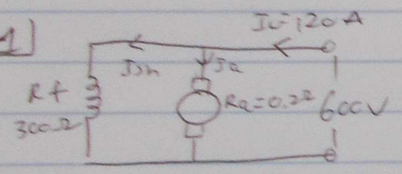
$P_e = K_e f^2 \cdot t^2 \cdot B^2 \cdot V$

$= 4 \cdot 50^2 \cdot (0.5 \times 10^{-3})^2 1^2 \cdot 8$

$= 2\,watt$

---

1)



Efficiency = ?

Rotational losses = 1.5 kw

$I_{sh} = \frac{600}{Rf} = \frac{600}{300} = 1.67A$ 2 A

$I_a = I_L - I_{sh} = 120A - 1.67A = 118.33A$ 118 A

Total copper loss $= I_a^2 \cdot Ra + I_{sh}^2 R_{sh}$

$= 120^2 \times 0.2 + 1.67^2 \times 300$

$= 2880 + 836.67 = 3716.67$

Total loss(s) = Copper losses + Rotational losses

$= 3,716.67 + 1,500 = 5,216.67$

Input power $= V_t \cdot I_L = 600 \times 120 = 72\,kw$

output power $= 72,000 - 5,21667 = 66,783.33$

efficiency $= \frac{66.78333}{72,000} \times 100 = 92.75\,\%$

Lang G 802093281

The winding Resistance of 600V, 600kW DC Shunt Gen $R_a = 0.2\Omega$ $R_f = 300\Omega$ Rotational losses are 1.5kW. Input current is 120A. find efficiency

$$I_{shunt} = \frac{600}{300} = 2A$$

$$I_a = I_L - I_{sh} = 120 - 2 = 118A$$

Total copper losses $= I_a^2 R_a + I_{sh}^2 R_{sh}$

$= 118^2 \times 0.2 + 2^2 \times 300$

$= 3984.8$

Total losses $= 3984.8 + 1500$

$= 5484.8W$

Input power $= 600 \times 120$

$= 72000W$

output power

= Input power − losses

$= 72000 - 5484.8$

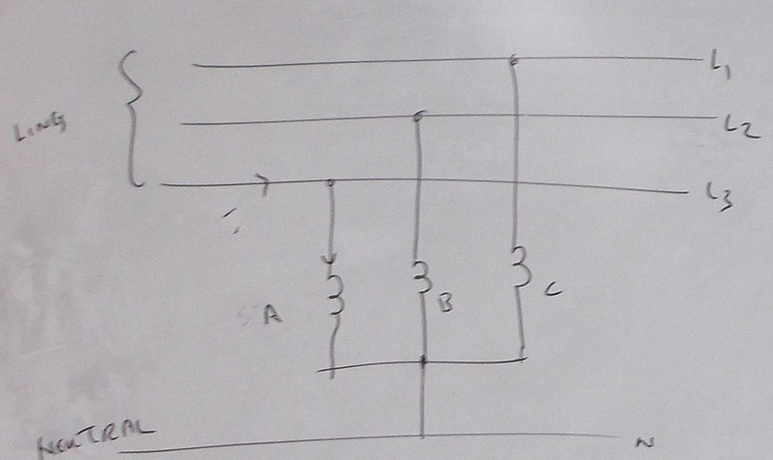
$= 66515.2W$

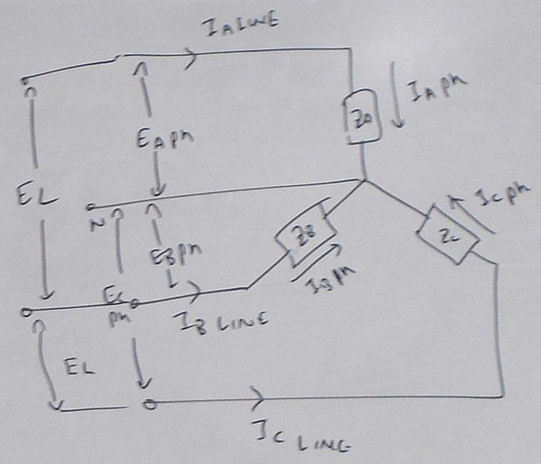
Efficiency $= \frac{\text{output power}}{\text{input power}}$

$= 0.9238$

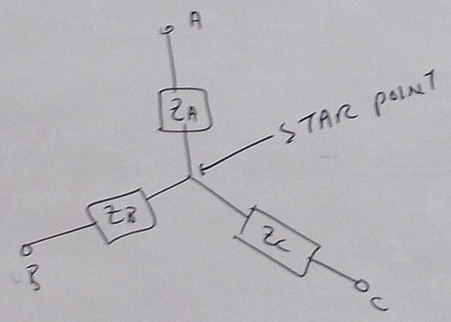
$= 92.38\%$

STAR CONNECTION





STAR CONNECTION



$I_{A\,LINE} = I_{A\,ph}$

$I_{B\,LINE} = I_{B\,ph}$

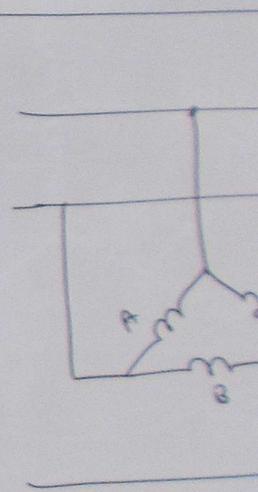
$I_{C\,LINE} = I_{C\,ph}$

$$E_{A\,ph} = E_{B\,ph} = E_{C\,ph} = \frac{E_{LINE}}{\sqrt{3}}$$

BALANCED 3ϕ POWER $= \sqrt{3}\, E_{LINE}\, I_{LINE} \times \cos\theta$

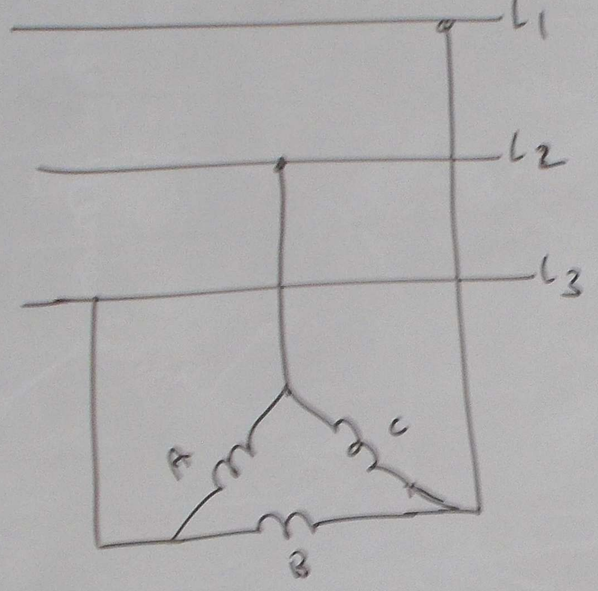
3ϕ POWER $= I^2_{A\,ph} R_A + I^2_{B\,ph} R_B + I^2_{C\,ph} R_C$

DELTA CONNECTION

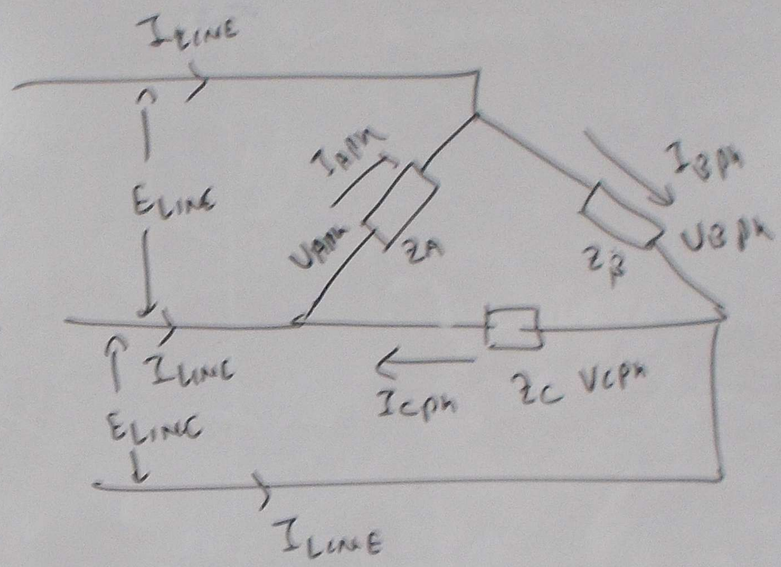


BAL
3

DELTA CONNECTION



≡



BALANCED DELTA

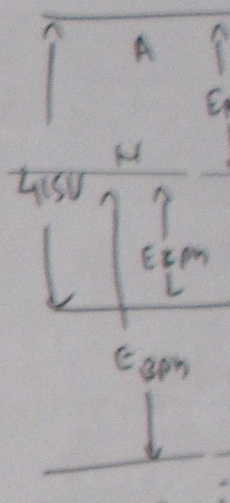
$$I_{LINE} = \sqrt{3}\, I_{APh} = \sqrt{3}\, I_{BPh} = \sqrt{3}\, I_{CPh}$$

$$E_{LINE} = E_{APh} = E_{BPh} = E_{CPh}$$

BALANCED 3ϕ POWER $= \sqrt{3}\, E_{LINE}\, I_{LINE} \cos\theta$

$$3\phi \text{ POWER} = I_{APh}^2 R_A + I_{BPh}^2 R_B + I_{CPh}^2 R_C$$

Ph



$Z_A = 3+j$

$Z_B = 3+j$

$Z_C = 3+$

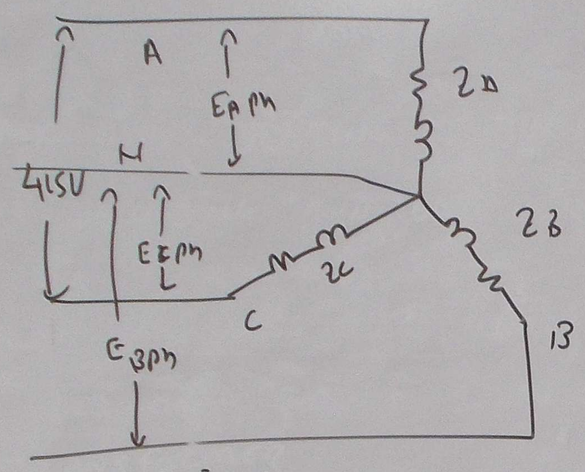
CALCULATE

$I_{LINE} \times \cos\theta$

$I_{BPh}^2 R_B + I_{CPh}^2 R_C$

$\sqrt{3} I_{CPh}$

ph



$Z_A = 3+j4\Omega$

$Z_B = 3+j4\Omega$

$Z_C = 3+j4\Omega$

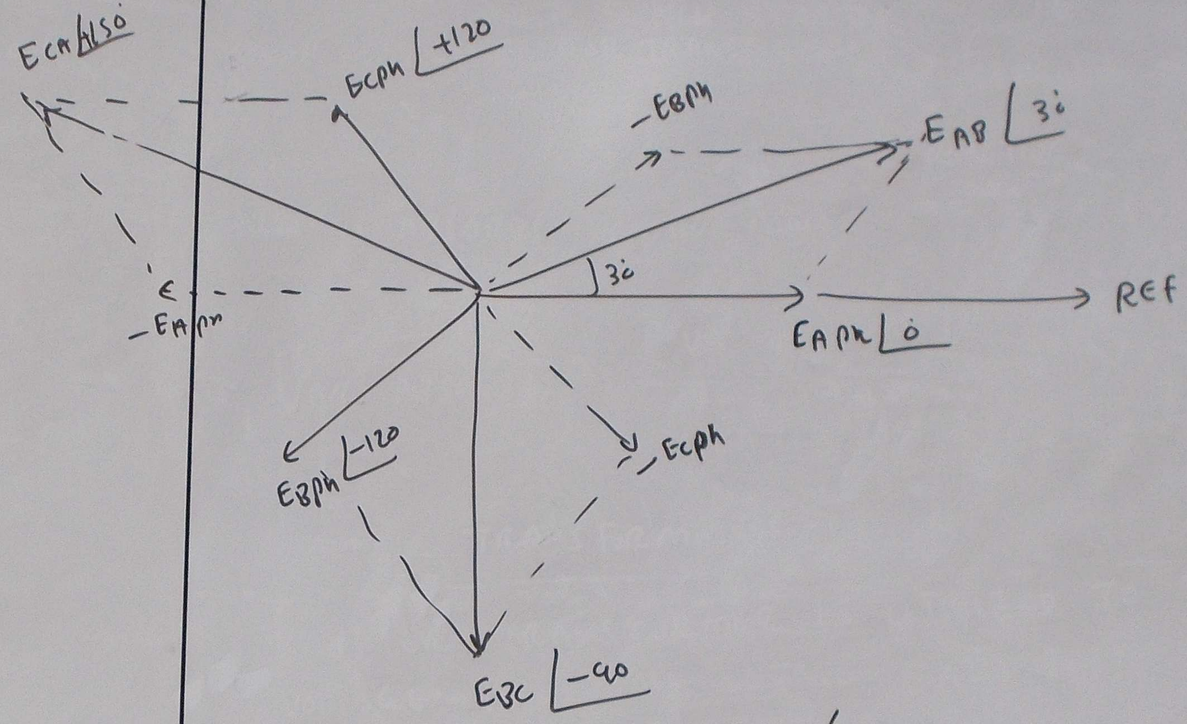
CALCULATE (a) E_{APh}, E_{BPh}, E_{CPh}

(b) I_{APh} I_{BPh} I_{CPh}

(c) I_{ALINE} I_{BLINE} I_{CLINE}

(d) 3ϕ POWER

(e) POWER FACTOR



(a) $E_{APh} = \frac{415}{\sqrt{3}} = 240\angle 0^\circ$ V

$E_{BPh} = 240\angle -120^\circ$ V

$E_{CPh} = 240\angle +120^\circ$ V

$E_{AB} = 415\angle 30^\circ$ V, $E_{BC} = 415\angle -90^\circ$ V, $E_{CA} = 415\angle +150^\circ$ V

(b) $Z_A = 3+j4 = \sqrt{3^2+4^2}\angle \tan^{-1}4/3$

$= 5\angle 53.1^\circ\ \Omega$

$Z_B = 3+j4 = 5\angle 53.2\ \Omega$

$Z_C = 3+j4 = 5\angle 53.2\ \Omega$

$$I_{APh} = \frac{E_{APh}}{Z_A} = \frac{240\angle 0}{5\angle 53.2} = 48\angle -53.2 \text{ AMP}$$

$$I_{BPh} = \frac{E_{BPh}}{Z_B} = \frac{240\angle 0}{5\angle 53.2} = 48\angle -53.2 \text{ AMP}$$

$$I_{CPh} = \frac{E_{CPh}}{Z_C} = \frac{240\angle 0}{5\angle 53.2} = 48\angle -53.2 \text{ AMP}$$

(c) $I_{A\,LINE} = I_{A\,Ph} = 48\angle -53.2$ AMP

$I_{B\,LINE} = I_{B\,Ph} = 48\angle -53.2$ AMP

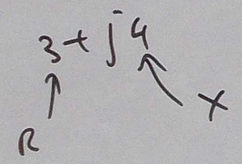
$I_{C\,LINE} = I_{C\,Ph} = 48\angle -53.2$ AMP

(d) 3ϕ POWER

$R_A = 3\,\Omega$,

$R_B = 3\,\Omega$

$R_C = 3\,\Omega$



$$3\phi \text{ POWER} = I_{APh}^2 R_A + I_{BPh}^2 R_B + I_{CPh}^2 R_C$$

$$= 48^2 \times 3 + 48^2 \times 3 + 48^2 \times 3$$

$$= 6912 + 6912 + 6912$$

$$= 20736 \text{ WATT}$$

(e) 3ϕ POWER $= \sqrt{3}\, E_{LINE}\, I_{LINE} \cos\theta$

BALANCED

$I_{LINE} = I_{APh} = I_{BPh} = I_{CPh}$

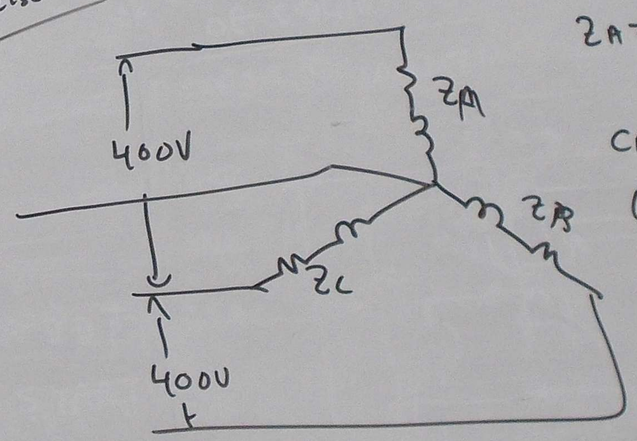
$= 48$ A

$$20736 = 1.7321 \times 415 \times 48 \cos\theta$$

$$\cos\theta = \frac{20736}{1.7321 \times 415 \times 48} = 0.6$$

LAGGING

EXERCISE



$Z_A = Z_B = Z_C = 4 + j3\,\Omega$

CALCULATE

(a) E_{APh} E_{BPh} E_{CPh}

(b) I_{APh} I_{BPh} I_{CPh}

(c) I_{ALINE} I_{BLINE} I_{CLINE}

(d) 3ϕ POWER

(e) POWER FACTOR

ELECTROMAGNETISM

ERICK MATIAS

1) $K_e = 4$, $K_h = 2$, $f = 50\,Hz$, $t = 0.5\,mm$, $B = 1\,T$, $V = 8\,m^3$
$m = 40\,kg$.

$= 0.5 \times 10^{-3}\,m$

Hysteresis Lose

$P_h = K_h \cdot f \cdot B^{1.6} \cdot m$

$= 2 \cdot 50 \cdot 1^{1.6} \cdot 40$

$= 159242.86\,watt$

$= 159.24\,kW$

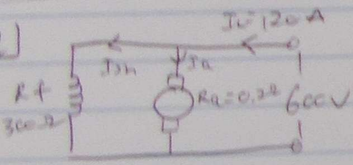
Eddy Current Lose

$P_e = K_e t^2 \cdot f^2 \cdot B^2 \cdot V$

$= 4 \cdot 50^2 \cdot (0.5 \times 10^{-3})^2 \cdot 1^2 \cdot 8$

$= 2\,watt$

1)



Efficiency = ?

Rotational losses = 1.5kw

$I_{sh} = \frac{600}{Rsh} = \frac{600}{300} = 2\,A$

$I_a = I_L - I_{sh} = 120A - 2A = 118A$

Total Copper loss = $I_a^2 \cdot Ra + I_{sh}^2 Rsh$

$= 120^2 \times 0.2 + 2^2 \times 300$

$= 2880 + 836.67 = 3716.67$

Total losses = Copper losses + Rotational losses

$= 3,716.67 + 1,500 = 5,216.67$

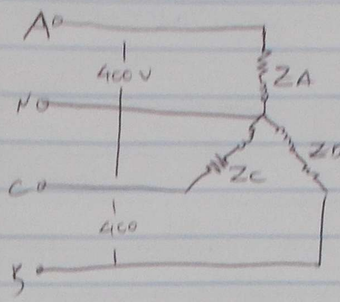
Input power = $V_t \cdot I_L = 600 \times 120 = 72\,kw$

Output power = $72,000 - 5,216.67 = 66,783.33$

Efficiency = $\frac{66.78333}{72,000} \times 100 = 92.75\,\%$

A, C

ERICK MATIAS 803737703



$Z_A = Z_B = Z_C = 4 + j3\,\Omega$

(a) E_{aphase}, E_{bph}, E_{cph}

(b) I_{aph}, I_{bph}, I_{cph}

(c) I_{aLine}, I_{bLine}, I_{cLine}

(d) 3φ power

(e) power factor

(a) $E_{aph} = \frac{400}{\sqrt{3}} = 230.94\,\angle 0$

$E_{bph} = \frac{400}{\sqrt{3}} = 230.94\,\angle -120$

$E_{cph} = \frac{400}{\sqrt{3}} = 230.94\,\angle +120$

(b) $I_{aph} = \frac{E_{aph}}{Z_a}$

$Z_a = 4 + j3 = \sqrt{4^2 + 3^2}\,\angle \tan^{-1}\frac{3}{4} = 5\,\angle 53.13$

$Z_a = Z_b = Z_c = 5\,\angle 53.13$

$I_{aph} = \frac{230.94\,\angle 0}{5\,\angle 53.13} = 46.18\,\angle -53.13$

$I_{Bph} = I_{cph} = I_{aph} = 46.18\,\angle -53.13$

(c) $I_{aLine} = I_{aph} = 46.18\,\angle -53.13$

$I_{bLine} = I_{Bph} = 46.18\,\angle -53.13$

$I_{cLine} = I_{cph} = 46.18\,\angle -53.13$

(d) 3φ power = $I_{Aph}^2 \cdot Ra + I_{Bph}^2 \cdot Rb + I_{cph}^2 \cdot Rc$

$= (46.18^2 \times 4) \times 3$

$= 8530.3696 \times 3$

$= 25,591.11\,watt$

(e) 3φ power = $\sqrt{3} \cdot E_{Line} \cdot I_{Line} \cdot \cos\theta$

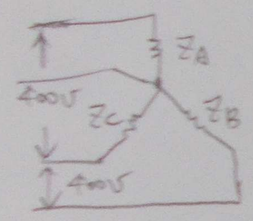
$25,591.11 = \sqrt{3} \cdot 400 \cdot 46.18 \cdot \cos\theta$

$\cos\theta = \frac{25,591.11}{31,994.44}$

$\cos\theta = 0.79$

Archer CHIU 20378904S

$Z_A = Z_B = Z_C = (4+j3)\,\Omega = 5\angle 37^\circ$



(a)
$$\begin{cases} E_{APN} = \frac{400}{\sqrt{3}}\angle 0^\circ = 230.9\angle 0^\circ \\ E_{BPN} = 230.9\angle -120^\circ \\ E_{CPN} = 230.9\angle 120^\circ \end{cases} \qquad \begin{cases} E_{AB} = 400\angle 30^\circ \\ E_{BC} = 400\angle -90^\circ \\ E_{CA} = 400\angle 150^\circ \end{cases}$$

(b)
$$\begin{cases} I_{APN} = \frac{230.9\angle 0^\circ}{5\angle 37^\circ} = 46.18\angle -37^\circ \\ I_{BPN} = 46.18\angle -157^\circ \\ I_{CPN} = 46.18\angle 83^\circ \end{cases} \#$$

(c)
$$\begin{cases} I_{A\,Line} = I_{APN} = 46.18\angle -37^\circ \\ I_{B\,Line} = I_{BPN} = 46.18\angle -157^\circ \\ I_{C\,Line} = I_{CPN} = 46.18\angle 83^\circ \end{cases} \#$$

(d) 3φ Power

$P = I^2R = 46.18^2 \times (4)\,\Omega$

$= 8.53\ kW$

$3P = 3 \times 8.53\ kW = 25.6\ kW$ #

(e)

$I_{Line} = I_{APN} = I_{BPN} = I_{CPN}$

$= 46.18\ A$

3φ Power $= I_{Line} E_{Line} \times \sqrt{3} \cos\theta$

$\cos\theta = 0.8$ #

a) $E_{APh} = \frac{400}{\sqrt{3}}$

$= 230.9\ V$

$E_{BPh} = 230.9 \angle -120\ V$

$E_{CPh} = 230.9 \angle +120\ V$

$E_{AB} = 400 \angle 30\ V$

$E_{BC} = 400 \angle -90\ V$

$E_{CA} = 400 \angle 150\ V$

b) $Z_A = 4+3j\ \Omega$

$= \sqrt{4^2+3^2} \angle \tan^{-1}\frac{3}{4}$

$= 5 \angle 36.9\ \Omega$

$Z_B = 5 \angle 36.9\ \Omega$

$Z_C = 5 \angle 36.9\ \Omega$

$I_{APh} = \frac{230.9}{5 \angle 36.9} = 46.18 \angle -36.9\ A$

$I_{BPh} = 46.18 \angle -36.9\ A$

$I_{CPh} = 46.18 \angle -36.9\ A$

c) $I_{A\,line} = 46.18 \angle -36.9\ A$

$I_{B\,line} = I_{bPh} = 46.18 \angle -36.9$

$I_{C\,line} = I_{cPh} = 46.18 \angle -36.9$

d) $R_A = 4\Omega$

$R_B = 4\Omega$

$R_C = 4\Omega$

3ϕ power $= 46.18^2 \times 4 \times 3$

$= 25591\ W$

e) 3ϕ power

$= \sqrt{3}\ E_{line} \cdot I_{line} \cdot \cos\theta$

$I_{line} = 46.18\ A$

$25591 = \sqrt{3} \times 400 \times 46.18 \cos\theta$

$\cos\theta = 0.799$

Lagging

Lag 6 80293781

d) 3ϕ power

R	X
4	+ 3j

$R_A = 4\Omega$
$R_B = 4\Omega$
$R_C = 4\Omega$

3ϕ power = $I_{APH}^2 \times R_A + I_{BPH}^2 \times R_B + I_{CPH}^2 \times R_C$

$46^2 \times 4 + 46^2 \times 4 + 46^2 \times 4$

3ϕ = 25392 watt

e) 3ϕ power = $\sqrt{3}$ E line I line cos θ

I line = $I_{APH} = I_{BPH} = I_{CPH}$ = Balanced = 46A

$25392 = \sqrt{3} \times 400 \times 46 \times \cos\theta$

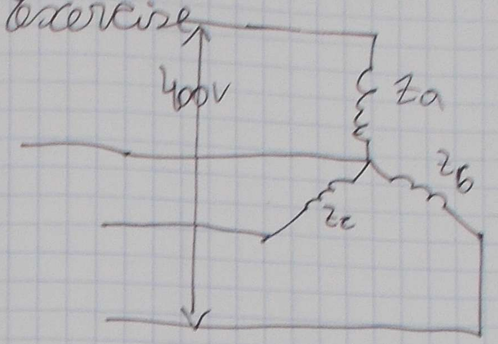
$\cos\theta = \frac{25392}{\sqrt{3} \times 400 \times 46} = 0.79$ lagging

MATEUS G BASEGGIO
80 3737657.

10/05/18

Star connection.

Exercise



$Z_a = Z_b = Z_c = 4 + j3\ \Omega$

Calculate a) $E_{APH}, E_{BPH}, E_{CPH}$
b) $I_{APH}, I_{BPH}, I_{CPH}$
c) I a line ...
d) 3ϕ Power
e) power factor.

a) $\frac{400}{\sqrt{3}}$ $E_{APH} = E_{BPH} = E_{CPH} = 230V$

$230\angle 0 = 230\angle -120 = 230\angle -240$

b) $Z_a = 4 + j3 = \sqrt{4^2 + 3^2} \angle \tan^{-1}\frac{3}{4} = 5\angle 36.86°$ $Z_a = Z_b = Z_c$

$I_{APH} = \frac{E_{APH}}{Z_a} = \frac{230\angle 0}{5\angle 36.86} = 46\angle -36.86$

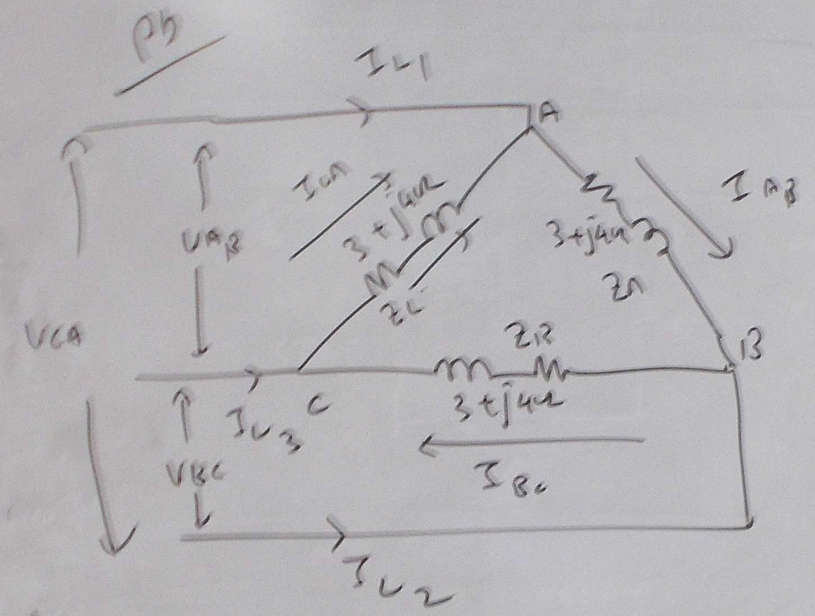
$I_{BPH} = \frac{E_{BPH}}{Z_b} = \frac{230\angle -120}{5\angle 36.86} = 46\angle -83.14°$

$I_{CPH} = \frac{E_{CPH}}{Z_c} = \frac{230\angle -240}{5\angle 36.86} \quad 46\angle -203.14°$

c) $I_{A\,line} = I_{APH} = 46\angle -36.86°$
$I_{B\,line} = I_{BPH} = 46\angle -83.14°$
$I_{C\,line} = I_{CPH} = 46\angle -203.14°$

DELTA CONNECTION

Pb



LINE VOLTAGE = 415V

IN THE GIVEN CIRCUIT, CALCULATE

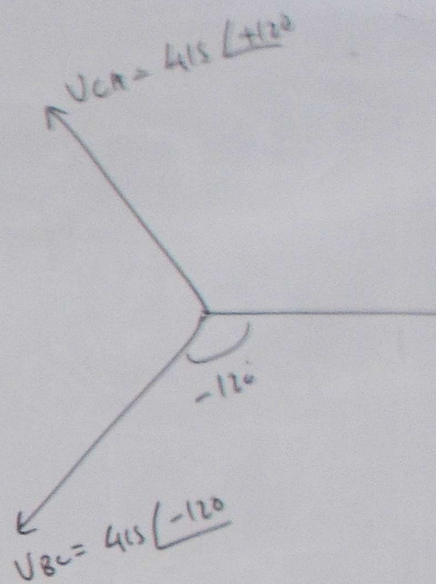
(a) CURRENTS FLOW THROUGH Z_A, Z_P, Z_C

(b) LINE CURRENTS

(c) PHASE VOLTAGES

(d) 3ϕ POWER

(e) POWER FACTOR



(a) $I_{ZA} = I_{AB} = \frac{V_{AB}}{Z_A} =$

$I_{ZB} = I_{BC} = \frac{V_{BC}}{Z_B} =$

$I_{ZC} = I_{CA} = \frac{V_{CA}}{Z_C} =$