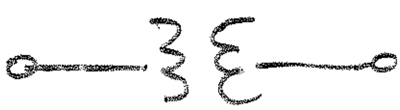
TRANSFORMER PROBLEMS

Q.1.

11 kV 132 kV



50 MVA
3ϕ

$X_{eq} = j5\,m\Omega$

$$Z_{base}^{HV} = \frac{132^2}{50} = 348.48\,\Omega$$

$$Z_{base}^{LV} = \frac{11^2}{50} = 2.42\,\Omega$$

ON THE LV SIDE

$$Z_{eq\,pu}^{LV} = j\frac{0.005}{2.42}$$

$$= j\,0.0021\text{ pu}$$

ON THE HV SIDE

$$X_{eq} = j\,0.005 \times \left(\frac{132}{11}\right)^2 = j\,0.72\,\Omega$$

HENCE

$$Z_{eq\,pu}^{HV} = j\frac{0.72}{348.48} = j\,0.0021$$

NOTE THAT

$$Z_{eq\,pu}^{HV} = Z_{eq\,pu}^{LV}$$

AS EXPECTED.

Q.2. ②

3ϕ BALANCED STAR CONNECTED $20\,\Omega$ LOAD

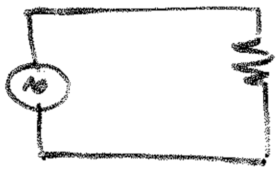
3ϕ
$400V$

$$S_{base\,3\phi} = 10\text{ kVA}$$

$$Z_{base} = \frac{V_{L\,base}^2}{S_{base\,3\phi}} = \frac{400^2}{10 \times 10^3} = 16\,\Omega$$

THE EQ. CCT. IS AS SHOWN BELOW

$\overline{V}_{ph} = 1\angle 0^\circ$



$$\overline{Z}_{pu} = \frac{20}{16} = 1.25\text{ pu}$$

THUS

$$\overline{I}_{pu} = \frac{\overline{V}_{pu}}{\overline{Z}_{pu}} = \frac{1.0\angle 0^\circ}{1.25\angle 0} = 0.8\text{ pu}$$

THE PER-UNIT COMPLEX POWER IS THUS

$$\overline{S}_{pu} = \overline{V}_{pu}\,\overline{I}_{pu}^{*}$$

$$= 1.0\angle 0^\circ \times 0.8\angle 0^\circ$$

$$= 0.8\text{ pu.}$$

CHECK :-

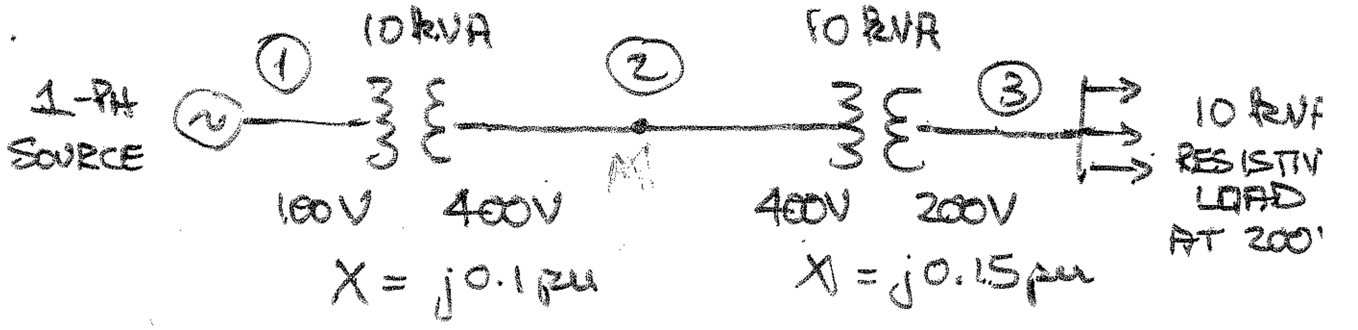
$$P = 3V_{ph}^2/R = V_L^2/R = 400^2/20$$

$$= 8\text{ kW.}$$

$$S = \overline{S}_{pu}\,S_{base}$$

$$= 0.8 \times 10\text{ kVA} = 8\text{ kW.}$$ ✓

Q.3.



CHOOSE 200V / 10 kVA AS BASE IN ZONE 3

HENCE

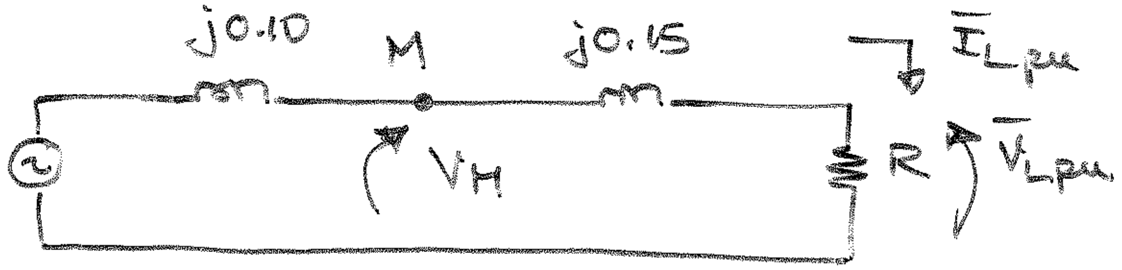
$$Z^3_{base} = \frac{200^2}{10 \times 10^3} = 4\,\Omega$$

$$Z^2_{base} = \frac{400^2}{10 \times 10^3} = 16\,\Omega$$

$$Z^1_{base} = \frac{100^2}{10 \times 10^3} = 1\,\Omega$$

THE TRANSFORMER SERIES REACTANCE VALUES ARE CONSISTENT WITH THE CHOSEN PU SYSTEM

THE EQ. CCT. IS THUS AS SHOWN BELOW



SINCE THE LOAD RESISTANCE CONSUMES THE BASE POWER THEN

$$\bar{Z}_{Lpu} = 1\angle 0^\circ$$

Q.3

ALSO SINCE

$$\bar{V}_L = 200\angle 0^\circ \ V$$

TAKING THE LOAD VOLTAGE AS REFERENCE THEN

$$\bar{V}_{Lpu} = 1.0\angle 0^\circ$$

AND SO

$$\bar{I}_{Lpu} = 1.0\angle 0^\circ.$$

THE VOLTAGE AT POINT M IS THEN GIVEN BY

$$\bar{V}_{Mpu} = \bar{V}_{Lpu} + \bar{I}_{Lpu}\bar{Z}_{T2\,eq,\,pu}$$

$$\Rightarrow \bar{V}_{Mpu} = 1.0 + (j0.15)(1.0\angle 0^\circ)$$

$$\Rightarrow \bar{V}_{Mpu} = (1 + j0.15)\ pu$$

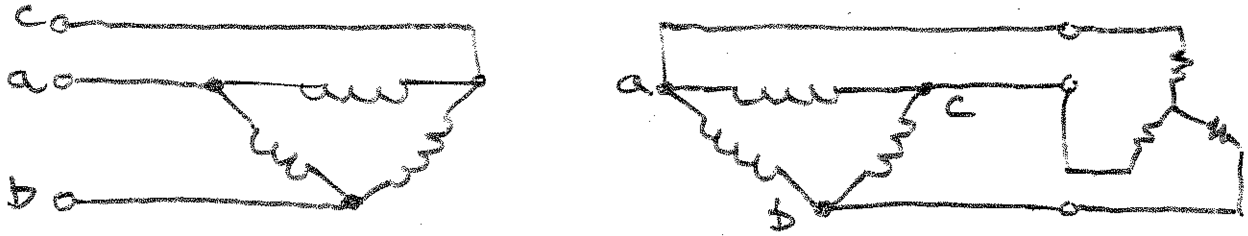
$$= 1.0112\angle 8.53^\circ\ pu.$$

HENCE

$$\bar{V}_M = 400 \times 1.0112\angle 8.53^\circ\ pu$$

$$\Rightarrow \bar{V}_M = 404.5\angle 8.53^\circ\ V.$$

Q. 4



SINGLE-PHASE TRANSFORMER SPECIFICATIONS

25 MVA, 34.5 kV/13.8 kV

RESISTIVE, BALANCED, THREE-PHASE LOAD

75 MW @ 13.8 kV.

(a) NORMAL Δ-Δ OPERATION

$$V_{HV}^{phase} = 34.5 \text{ kV}$$

$$V_{LV}^{phase} = 13.8 \text{ kV}$$

$$\bar{S}_{3\phi} = 75 \angle 0^\circ \text{ MVA}$$

$$\Rightarrow \bar{S}_{1\phi} = 25 \angle 0^\circ \text{ MVA}$$

THUS $$I_{LV}^{phase} = \frac{25 \times 10^6}{13.8 \times 10^3} = 1811.6 \text{ A}$$

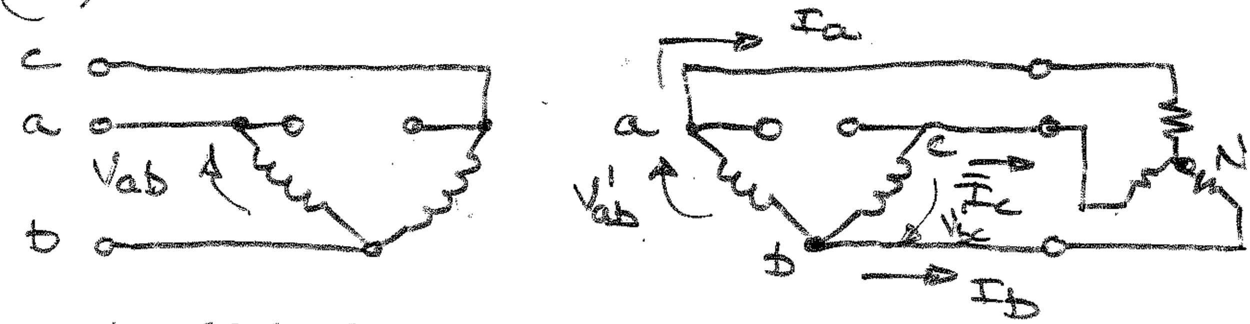
AND $$I_{LV}^{line} = \sqrt{3}\, I_{LV}^{phase} = 3137.8 \text{ A}$$

CHECK :-

$$S_{OUT} = \sqrt{3}\, V_L I_L$$
$$= \sqrt{3}\ 13.8 \times 10^3 \times 3137.8 \text{ VA}$$
$$= 75 \text{ MVA} \checkmark$$

Q.4.

(b) OPEN V CONNECTION



IN GENERAL,

$$V_{ab} + V_{bc} + V_{ca} = 0$$

AND

$$V'_{ab} + V'_{bc} + V'_{ca} = 0$$

THUS

$$V_{ca} = -(V_{ab} + V_{bc})$$

$$V'_{ca} = -(V'_{ab} + V'_{bc})$$

SINCE V_{ab} AND V_{bc} REMAIN UNCHANGED THEN V'_{ab} AND V'_{bc} ARE ALSO UNCHANGED AND THUS THE LOAD VOLTAGES ARE ALSO UNCHANGED.

HOWEVER, THE MAXIMUM POSSIBLE LOAD CURRENT IS NOW A TRANSFORMER PHASE CURRENT, NOT A LINE CURRENT, AND SO THE MAXIMUM LOAD MUST BE REDUCED BY $\sqrt{3}$.

IN THIS CASE

$$I_{LV}^{line} = \frac{S_{LOAD}}{\sqrt{3}\, V_{LOAD}}$$

Q.4

$$I_{LV}^{line} = \frac{43.3 \times 10^6}{\sqrt{3} \times 13.8 \times 10^3} = 1811.6\ A$$

HENCE, THE LOAD ON THE TWO REMAINING TRANSFORMERS IS

$$S_{TRAFO} = V_{LV}^{phase} \ I_{LV}^{line}$$

$$= 13.8 \times 10^3 \times 1811.6 \ VA$$

$$= 25 \ MVA \checkmark$$

SPECIFICALLY, TAKING $\bar{V}_{aN}$ AS REFERENCE

$$\bar{V}'_{aN} = \frac{13.8}{\sqrt{3}} \angle 0^\circ \ kV$$

$$\bar{V}'_{bN} = \frac{13.8}{\sqrt{3}} \angle -120^\circ \ kV$$

$$\bar{V}'_{cN} = \frac{13.8}{\sqrt{3}} \angle +120^\circ \ kV$$

HENCE

$$\bar{V}'_{ab} = 13.8 \angle 30^\circ \ kV$$

$$\bar{V}'_{bc} = 13.8 \angle -90^\circ \ kV$$

THE COMPLEX POWER DELIVERED BY TRANSFORMER ab IS

$$\bar{S}_{ab} = \bar{V}'_{ab} \bar{I}_a^*$$

$$= (13.8 \angle 30^\circ)(1811.6 \angle 0^\circ) \ kVA$$

$$= 25 \angle 30^\circ \ MVA$$

Q.4.

THE COMPLEX POWER DELIVERED BY TRANSFORMER bc IS

$$\bar{S}_{bc} = -\bar{V}_{bc}' \bar{I}_c^*$$

$$= -(13.8\angle -90^\circ)(1811.6\angle +120^\circ)^* \text{ kVA}$$

$$= 25\angle -30^\circ \text{ MVA}.$$

HENCE

$$\bar{S}_{ab} = (21.65 + j\,12.5) \text{ MVA}$$

$$\bar{S}_{bc} = (21.65 - j\,12.5) \text{ MVA}$$

THE OPEN DELTA TRANSFORMER IS NOT OVERLOADED. IN SUPPLYING THE REAL POWER OF $21.65 + 21.65 = 43.3$ MW, TRANSFORMER ab GENERATES 12.5 MVAr WHILE TRANSFORMER bc ABSORBS 12.5 MVAr.

TRANSFORMERS.

Q.5 THREE SINGLE-PHASE 50 KVA, 2300V/230V, 50 Hz TRANSFORMERS ARE CONNECTED TO FORM A THREE-PHASE, 4000V/230V TRANSFORMER BANK. THE EQUIVALENT IMPEDANCE OF EACH TRANSFORMER REFERRED TO THE LOW VOLTAGE WINDING IS $(0.012+j0.016)$ Ω. THE THREE-PHASE TRANSFORMER SUPPLIES A THREE-PHASE, 120 KVA, 230V, 0.85 pf LAGGING LOAD.

(i) DRAW A SCHEMATIC DIAGRAM OF THE TRANSFORMER CONNECTION

(ii) CALCULATE THE TRANSFORMER WINDING CURRENTS

(iii) CALCULATE THE PRIMARY VOLTAGE REQUIRED TO PROVIDE THE LOAD

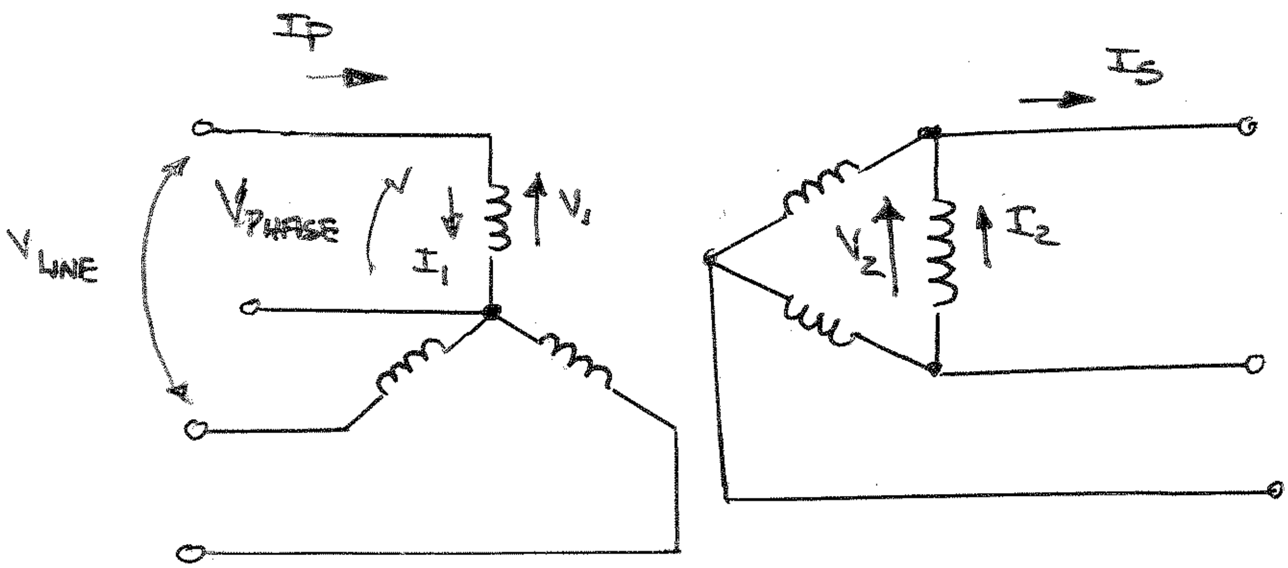
(iv) ESTIMATE THE VOLTAGE REGULATION OF THE DEVICE.

SOLUTION :-

SINCE THE LOAD VOLTAGE IS 230V, THE SECONDARY MUST BE CONNECTED IN DELTA.

SINCE THE SOURCE VOLTAGE IS 4000V AND THE RATED PRIMARY VOLTAGE IS 2300V, THE PRIMARY MUST BE CONNECTED IN STAR

$$V_{LINE} = \sqrt{3}\, V_{PHASE} \doteq 4000V$$



FOR THE SPECIFIED LOAD,

$$I_S = \frac{120 \times 10^3}{\sqrt{3} \times 230} = 301.2\,A$$

HENCE

$$I_2 = \frac{I_S}{\sqrt{3}} = 173.9\,A$$

EACH SINGLE-PHASE TRANSFORMER HAS A TURNS RATIO a_t OF

$$a_t = \frac{2300}{230} = 10$$

SO THAT THE PRIMARY CURRENT IS

$$I_1 = I_P = \frac{I_2}{a_t} = 17.39\,A$$

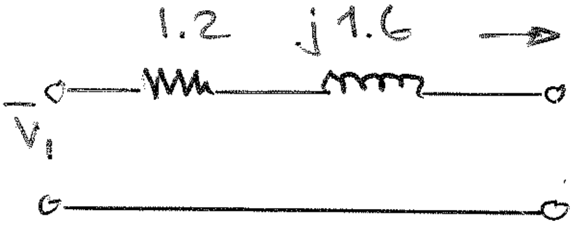
THE EQ. IMPEDANCE OF THE TRANSFORMER ON THE PRIMARY SIDE IS THEN

$$\bar{Z}_{eq}^{\lambda} = a_t^2\, \bar{Z}_{eq}$$

$$\bar{Z}_{eq}^{Y} = 10^2(0.012 + j0.016)\ \Omega$$

$$= (1.2 + j\,1.6)\ \Omega.$$

THE PER-PHASE EQ. CCT. ON THE HV SIDE IS THEN AS FOLLOWS.



$\longrightarrow \bar{I}_1 = 17.39 \angle -\cos^{-1} 0.8$

$\bar{V}_2' = a_t V_2 \angle 0^\circ$

$= 2300\,V.$

THE REQUIRED INPUT VOLTAGE IS THEN

$$\bar{V}_1 = 2300 \angle 0^\circ + (17.39 \angle -\cos^{-1} 0.85) \times (1.2 + j1.6)$$

$$\Rightarrow \bar{V}_1 = 2300 + (17.39 \angle -31.8^\circ)(2 \angle 53.1^\circ)$$

$$\Rightarrow \bar{V}_1 = 2332.4 \angle 0.31^\circ$$

THE REQUIRED LINE VOLTAGE IS

$$\bar{V}_{LINE} = 4039.8 \angle 0.31^\circ$$

THE VOLTAGE REGULATION IS

$$\%\ \text{REGULATION} = \left(\frac{2332.4 - 2300}{2300}\right) \times 100$$

$$= 1.41\ \%$$

Q.6. TRANSFORMERS.

$$V_p = 6.6 \text{ kV}$$

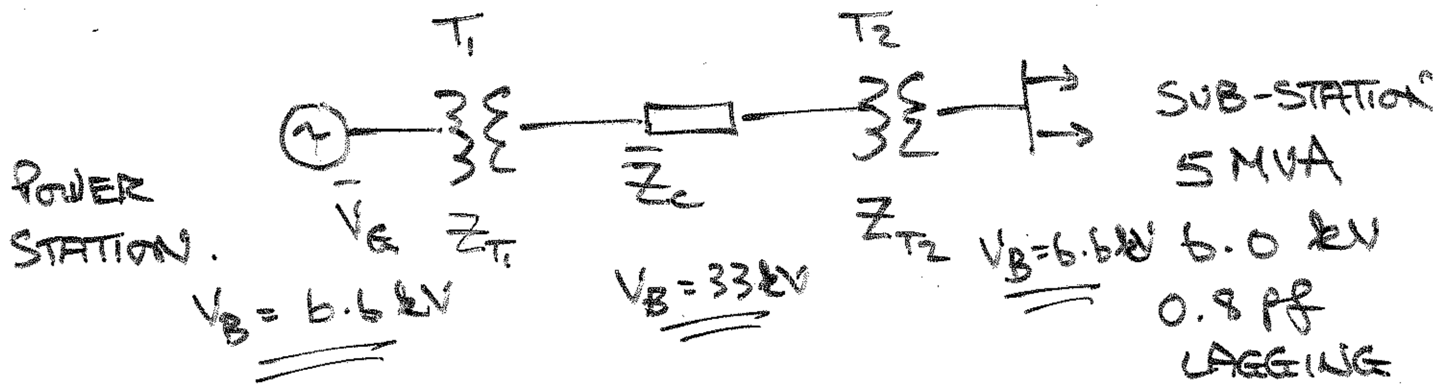
$$V_s = 33 \text{ kV}$$

$$n = \frac{V_s}{V_p} = 5$$

$$S = 10 \text{ MVA}.$$

$$Z_{BP} = \frac{6.6^2}{10} = 4.356 \ \Omega$$

$$Z_{Bs} = \frac{33^2}{10} = 108.9 \ \Omega$$



$$Z_{Tpu} = \frac{0.04 + j0.4}{4.356} \text{ pu}$$

$$= 0.0923 \angle 84.3^\circ \text{ pu}$$

$$\bar{Z}_{cpu} = \frac{7.17 + j\,2.0}{108.9} \text{ pu}$$

$$= 0.068 \angle 15.58^\circ \text{ pu}$$

Q.6.

$$V_{Lpu} = \frac{5 \times 10^3}{6.6 \times 10^3}$$

$$= 0.909 \ pu.$$

$$\bar{S}_L = \frac{5 \times 10^6}{0.8} \angle +\cos^{-1}(0.8)$$

$$= 6.25 \angle 36.86^\circ \ MVA$$

$$\Rightarrow \bar{S}_{Lpu} = 0.625 \angle 36.86^\circ \ pu$$

$$\bar{I}_{Lpu} = \left(\frac{\bar{S}_{Lpu}}{V_{Lpu}} \right)^*$$

$$= 0.6875 \angle -36.86^\circ \ pu$$

HENCE,

$$\bar{V}_{G\,pu} = \bar{V}_{Lpu} + \bar{I}_{Lpu} \bar{Z}_{eq\,pu}$$

WHERE

$$\bar{Z}_{eq\,pu} = \bar{Z}_{Tpu} + \bar{Z}_{Cpu} + \bar{Z}_{Tpu}$$

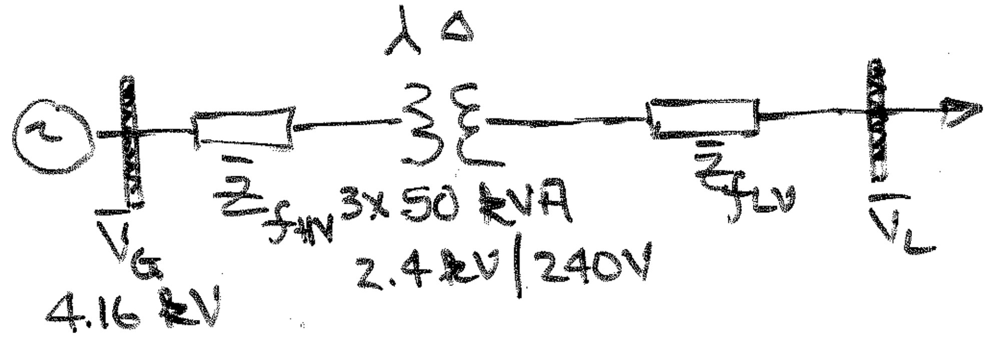
$$\Rightarrow \bar{V}_{G\,pu} = 0.909 + (2 \times 0.0923 \angle 84.3^\circ + 0.068 \angle 15.6^\circ)(0.6875 \angle -36.86^\circ)$$

$$= 1.0415 \angle 4.21^\circ \ pu$$

$$\Rightarrow \bar{V}_{G\,act} = 1.0415 \times 6.6 \ kV$$

$$= 6.875 \ kV. \ (\text{LINE})$$

Q.7.



$S_L = 150$ kVA
@ 0.8 pf LAGGING

TRANSFORMER SHORT CIRCUIT TEST RESULTS:

$V_{sc} = 48\text{V}$

$I_{sc} = 20.8\text{ A}$

$P_{sc} = 617\text{ W}$

MEASURED ON THE HV SIDE.

BASE POWER : $S_B = 50\text{ kVA}\ 1\phi$

$= 150\text{ kVA}\ 3\phi$

BASE VOLTAGE LV : $V_{B_{LV}} = 240\text{ V}\ 1\phi | 3\phi$

$V_{B_{HV}} = 2400\text{ V}\ 1\phi$

$= 4157\text{ V}\ 3\phi$

$$Z_{B_{HV}} = \frac{V_{B_{HV}}^2}{S_B} = 115.2\ \Omega$$

$$Z_{B_{LV}} = \frac{V_{B_{LV}}^2}{S_B} = 0.384\ \Omega$$

Q.7.

TRANSFORMER PARAMETERS REFERRED TO THE HV SIDE :- (2)

$$Z_{sc} = \frac{V_{sc}}{I_{sc}} = \frac{48}{20.8}\ \Omega$$

$$= 2.308\ \Omega$$

$$P_{sc} = I_{sc}^2 R_{sc}$$

$$\Rightarrow \quad R_{sc} = \frac{P_{sc}}{I_{sc}^2}$$

$$= \frac{617}{20.8^2}$$

$$= 1.426\ \Omega$$

$$X_{sc} = \sqrt{Z_{sc}^2 - R_{sc}^2}$$

$$= \sqrt{2.308^2 - 1.426^2}$$

$$= 1.814\ \Omega$$

$$\Rightarrow \quad \bar{Z}_{eq} = (1.426 + j1.814)\ \Omega$$

$$\Rightarrow \quad \bar{Z}_{Tpu} = \frac{\bar{Z}_{eq}}{Z_{BHV}}$$

$$= 0.020 \angle 51.8^\circ \text{ pu}$$

$$\bar{Z}_{fHV} = \frac{0.15 + j1.0}{115.2}$$

Q.7. (3)

$$\bar{Z}_{f HV pu} = 8.8 \times 10^{-3} \angle 81.47^\circ \text{ pu}$$

$$\bar{Z}_{f LV pu} = \frac{(0.5 + j2.0)\,10^{-3}}{0.384}$$

$$= 5.37 \times 10^{-3} \angle 75.9^\circ \text{ pu.}$$

FOR RATED POWER,

$$\bar{I}_L = 1.0 \angle -\cos^{-1}(0.8)$$

$$\bar{V}_{G pu} = \frac{4.16}{4.16} \angle 0^\circ = 1.0 \angle 0^\circ$$

THE PU LOAD VOLTAGE IS

$$\bar{V}_{L pu} = \bar{V}_{G pu} - \bar{I}_{L pu}\left[\bar{Z}_{f HV pu} + \bar{Z}_{T pu} + Z_{f LV pu}\right]$$

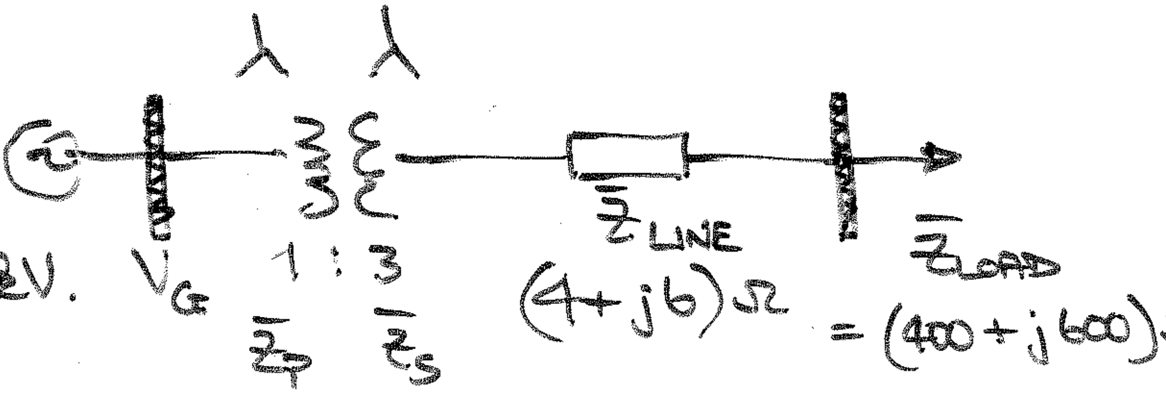
$$\Rightarrow \bar{V}_{L pu} = 1.0 - \left(1.0 \angle -36.87^\circ\right)\left(33.2 \times 10^{-3} \angle 63.18^\circ\right)$$

$$= 0.971 \angle -0.869^\circ \text{ pu}$$

$$\Rightarrow V_L = V_{L pu} \times V_{B LV}$$

$$= 233\text{ V}.$$

Q. 8.



$$n = 3$$

$$\bar{Z}_{LOAD} = (400 + j\,600)\ \Omega$$

$$\bar{Z}_{LINE} = (4 + j6)\ \Omega$$

$$\bar{Z}_S = (5 + j\,25)\ \Omega$$

ALSO THE TRANSFORMER PRIMARY IMPEDANCE REFERRED TO THE SECONDARY SIDE IS

$$Z_{P-S} = n^2 \bar{Z}_P$$

$$= (3)^2 (0.5 + j\,2.5)$$

$$= (4.5 + j\,22.5)\ \Omega$$

THE LV PHASE VOLTAGE IS GIVEN BY

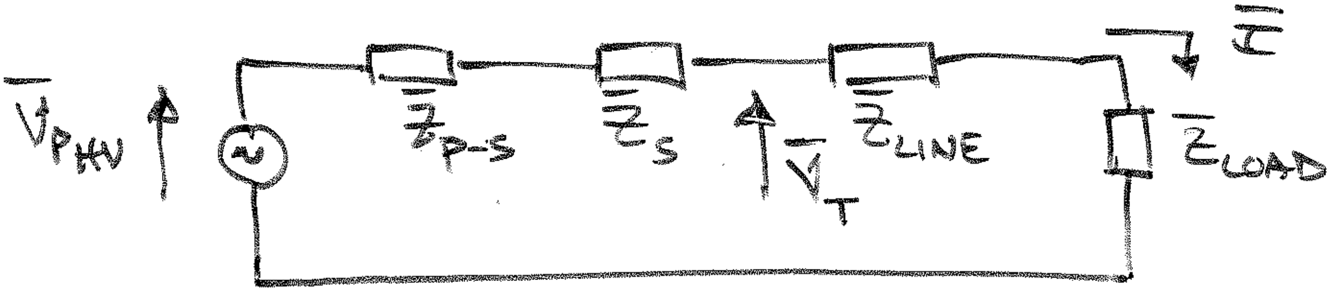
$$V_{P_{LV}} = \frac{11}{\sqrt{3}}\ \text{kV} = 6351 \angle 0^\circ\ \text{V}$$

REFERRING THIS VOLTAGE TO THE HV SIDE IS

$$V_{\text{[illegible]}} = n\,V_{P_{LV}} = 19.05 \angle 0^\circ\ \text{kV}$$

Q.8 ②

THE EQ. CCT. IS THUS AS SHOWN BELOW, REFERRED TO THE HV SIDE.



THE LOAD CURRENT REFERRED TO THE HV SIDE IS THEN

$$\bar{I} = \frac{\bar{V}_{PHV}}{\bar{Z}_{P-S} + \bar{Z}_S + \bar{Z}_{LINE} + \bar{Z}_{LOAD}}$$

$$= \frac{19.05 \times 10^3 \angle 0^\circ}{773.3 \angle 57.6^\circ}$$

$$= 24.63 \angle -57.6^\circ \text{ A}$$

THE TRANSFORMER SECONDARY VOLTAGE IS THEN

$$\bar{V}_T = \bar{V}_{PHV} - \bar{I}\left(\bar{Z}_{PS} + \bar{Z}_S\right)$$

$$= 17.994 \angle -1.37^\circ \text{ kV}$$

HENCE

$$V_{T\,LINE} = \sqrt{3}\, V_T$$

$$= 31.1 \text{ kV. LINE.}$$

Q.9 TRANSFORMERS.

A THREE-PHASE, 230V, 27 KVA, 0.9 pf LAGGING LOAD IS SUPPLIED BY THREE 10 KVA, 1330V/230V, 50 Hz TRANSFORMERS, CONNECTED IN A STAR/DELTA CONFIGURATION, VIA A FEEDER LINE WHOSE IMPEDANCE IS $(0.003 + j\,0.015)\ \Omega$/PHASE.

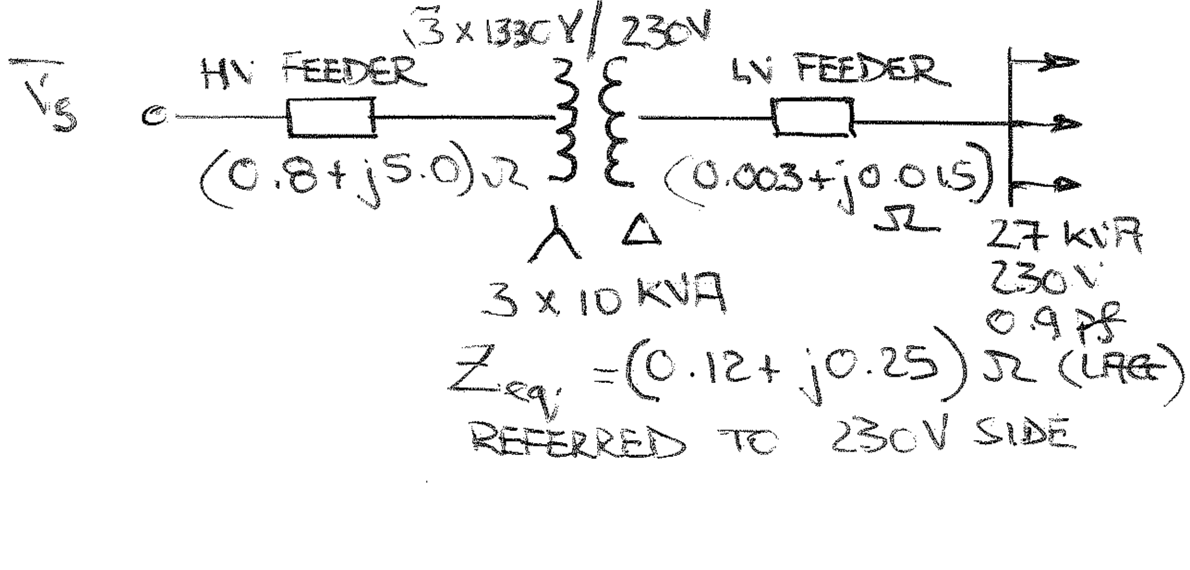
THE TRANSFORMER BANK IS FED VIA A HV FEEDER LINE WHOSE IMPEDANCE IS $(0.8 + j\,5.0)\ \Omega$/PHASE.

THE EQUIVALENT SERIES IMPEDANCE OF ONE TRANSFORMER REFERRED TO THE LV SIDE IS $(0.12 + j\,0.25)\ \Omega$/PHASE.

CALCULATE THE REQUIRED SUPPLY VOLTAGE IF THE LOAD VOLTAGE IS 230V.

SOLUTION :-

A SINGLE LINE DIAGRAM CORRESPONDING TO THIS SYSTEM IS SHOWN BELOW.



Q.9.

SELECT BASE VALUES :-

$$V_{BASE\ HV} = \sqrt{3} \times 1330 = 2300\ V$$

$$V_{BASE\ LV} = 230\ V.$$

$$S_{BASE\ 3\phi} = 3 \times 10\ KVA = 30\ KVA.$$

$$Z_{BASE\ HV} = \frac{V_{BASE\ HV}^2}{S_{BASE\ 3\phi}} = 176.33\ \Omega$$

$$Z_{BASE\ LV} = \frac{V_{BASE\ LV}^2}{S_{BASE\ 3\phi}} = 1.76\ \Omega$$

HENCE,

$$\overline{Z}_{F\ HV\ pu} = \frac{0.8 + j5.0}{176.33} = 28.72 \times 10^{-3} \underline{/80.9^\circ}$$

AND

$$Z_{F\ LV\ pu} = \frac{0.003 + j0.015}{1.76} = 8.69 \times 10^{-3} \underline{/78.7^\circ}$$

THE BASE IMPEDANCE FOR THE SINGLE-PHASE TRANSFORMER IS

$$Z_{BASE\ T} = \frac{230^2}{10 \times 10^3} = 5.29\ \Omega$$

Q.9

HENCE, THE PER UNIT IMPEDANCE OF THE TRANSFORMER IS

$$\bar{Z}_{T\,pu} = \frac{\bar{Z}_{eq}}{Z_{BASE\,T}} = \frac{0.12 + j0.25}{5.29}$$

$$= 0.0542 \angle 64.36^\circ \text{ pu.}$$

THUS THE TOTAL SERIES IMPEDANCE IN PU FROM LOAD TO SOURCE IS

$$Z_{SERIES\,pu} = \bar{Z}_{FHV\,pu} + \bar{Z}_{T\,pu} + \bar{Z}_{FLV\,pu}$$

$$= 88.97 \times 10^{-3} \angle 71.03^\circ \text{ pu}$$

THE PU LOAD COMPLEX POWER IS

$$\bar{S}_{L\,pu} = \frac{27 \times 10^3 \angle \cos^{-1} 0.9}{30 \times 10^3}$$

$$\Rightarrow \bar{S}_{L\,pu} = 0.9 \angle 25.84^\circ \text{ pu.}$$

THE PU LOAD VOLTAGE IS

$$\bar{V}_{L\,pu} = \frac{230 \angle 0^\circ}{230}$$

$$= 1.0 \angle 0^\circ \text{ pu}$$

Q.9.

Now since

$$\bar{S}_{L\,pu} = \bar{V}_{L\,pu}\, \bar{I}_{L\,pu}^{*}$$

Then

$$\bar{I}_{L\,pu} = \left(\frac{\bar{S}_{L\,pu}}{\bar{V}_{L\,pu}} \right)^{*}$$

$$\Rightarrow \quad \bar{I}_{L\,pu} = \left(\frac{0.9 \angle 25.84^\circ}{1.0 \angle 0^\circ} \right)^{*}$$

$$\Rightarrow \quad \bar{I}_{L\,pu} = 0.9 \angle -25.84^\circ$$

HENCE THE PU SOURCE VOLTAGE IS

$$\bar{V}_{s\,pu} = \bar{V}_{L\,pu} + \bar{Z}_{SERIES\,pu}\, \bar{I}_{L\,pu}$$

$$= 1.0 + (88.97 \times 10^{-3} \angle 71.03^\circ)(0.9 \angle -25.84^\circ)$$

$$= 1.0579 \angle 3.08^\circ \text{ pu.}$$

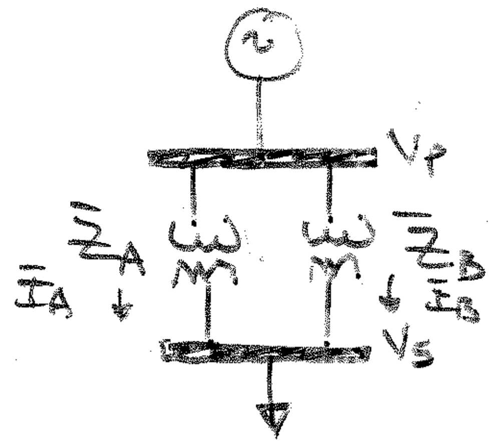
HENCE, THE ACTUAL PHASE VOLTAGE IS

$$V_{PHASE} = 1.0579 \times 1330 = 1407\,V$$

AND

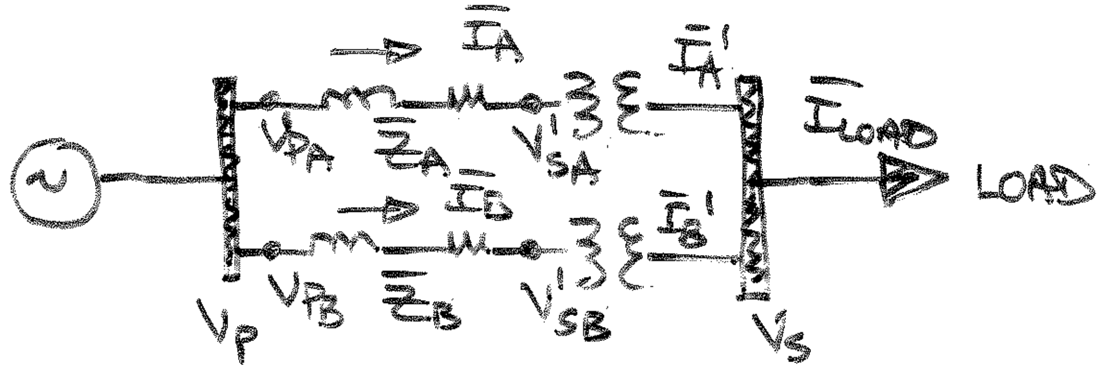
$$V_{LINE} = \sqrt{3}\, V_{PHASE} = 2437\,V.$$

Q.10



$$I_A = 100 \angle -\cos^{-1} 0.7 \; A$$
$$= 100 \angle -45.6^\circ \; A$$

THE EQ. CCT. IS AS FOLLOWS



CLEARLY,

$$V_{SA}' = V_{SB}'$$

SINCE $\quad V_{PA} = V_{PB}$

THEN

$$\bar{I}_A \bar{Z}_A = \bar{I}_B \bar{Z}_B$$

$$\Rightarrow \bar{I}_B = \left(\frac{\bar{Z}_A}{\bar{Z}_B} \right) \bar{I}_A$$

$$= \left(\frac{0.5 + j\,1.5}{0.6 + j\,1.8} \right) 100 \angle -45.6^\circ$$

$$= 0.833 \times 100 \angle -45.6^\circ \; A$$

Q.10

$$\bar{I}_B = 83.3 \angle -45.6^\circ \text{ A.}$$

THE TOTAL LOAD CURRENT REFERRED TO THE LV SIDE IS

$$I'_{LOAD} = \bar{I}_A + \bar{I}_B$$

$$= 100 \angle -45.6^\circ + 83.3 \angle -45.6^\circ$$

$$= 183.3 \angle -45.6^\circ \text{ A}$$

HENCE, THE TOTAL OUTPUT CURRENT ON THE HV SIDE IS

$$\bar{I}_{LOAD} = \frac{I'_{LOAD}}{n}$$

$$= \frac{183.3 \angle -45.6^\circ}{3} \text{ A}$$

$$= 61.1 \angle -45.6^\circ \text{ A.}$$