REVIEW QUESTION 1/4

Q1 HOW WILL YOU CHECK POLARITY OF TRANSFORMER FOR PARALLEL OPERATION?

Q2 DESCRIBE HOW INSULATION AND VOLTAGE LEVEL DETERMINE THE ARRANGEMENT OF WINDINGS?

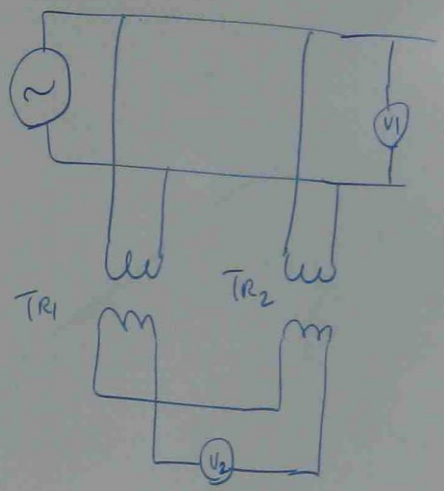
Q3 WRITE THE EFFICIENCY EQUATION FOR TRANSFORMER

Q4 WRITE THE EQUATION TO CALCULATE MAXIMUM EFFICIENCY

Q5 DRAW THE APPROXIMATE EQUIVALENT CIRCUIT OF ONE PHASE OF 3ϕ TRANSFORMER

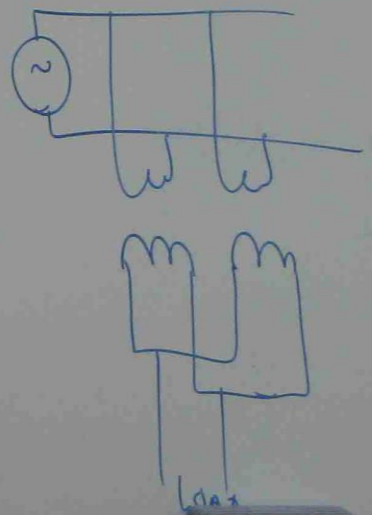
Q6 DRAW THE BLOCK DIAGRAM FOR (i) NO LOAD TEST (ii) SHORT CIRCUIT TEST

Q1



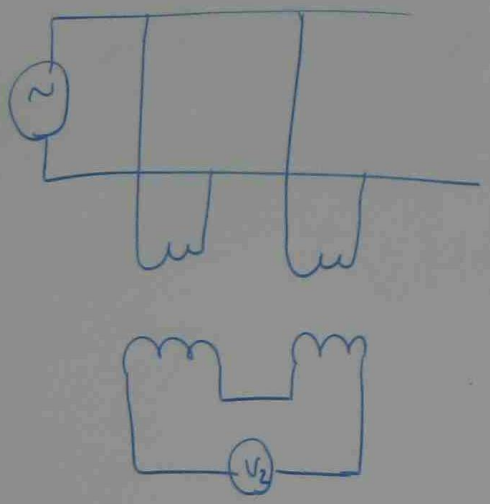
$V_2 \simeq 0$

THEN CONNECT



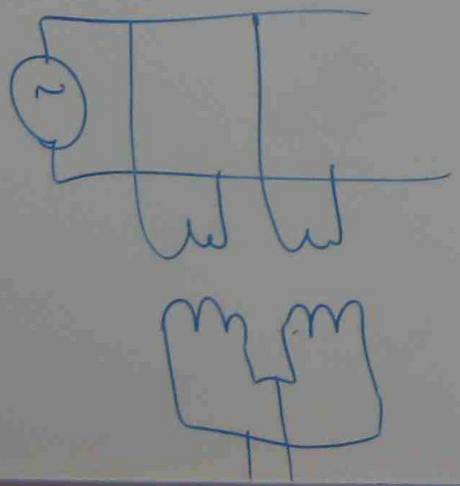
U_2 = LINE VOLTAGE (U_1)

CHANGE CONNECTION & RE-TEST



IF $V_2 \simeq 0$

THEN CONNECT



FLEXIBLE DELIVERY WEB SITE NOTES

IF YOU CAN NOT GET DOWN LOAD

— GIVE ME YOUR USB TO COPY

(OR)

SEND USB BY POST TOGETHER WITH STAMPED & ADDRESSED ENVELOPE TO

TO- UKYAW NAING
PO BOX 227
MARRICKVILLE
NSW 1475

Q2 L.V WINDING HAS LARGER CROSS SECTIONAL AREA AND LESS INSULATION THEY ARE MOUNTED RIGHT NEXT TO THE CORE TO ACHIEVE A BETTER SPACING FACTOR.

THE H.V WINDING REQUIRES MORE INSULATION MATERIAL TO WITHSTAND THE LARGER VOLTAGE. THEY ARE MOUNTED NEXT TO L.V WINDING.

Q3 $$\% \text{ EFFICIENCY} = \frac{L \times \text{Full load V.A} \times PF}{L \times \text{Full load V.A} \times PF + P_{oc} + L^2 P_{sc}} \times 100$$

$$L = \text{LOAD RATIO} = \frac{\text{ANY LOAD}}{\text{FULL LOAD}}$$

V.A = VOLT-AMP

P_{oc} = OPEN CIRCUIT LOSS (IRON LOSS)

P_{sc} = SHORT CIRCUIT LOSS (COPPER LOSS)

Q4

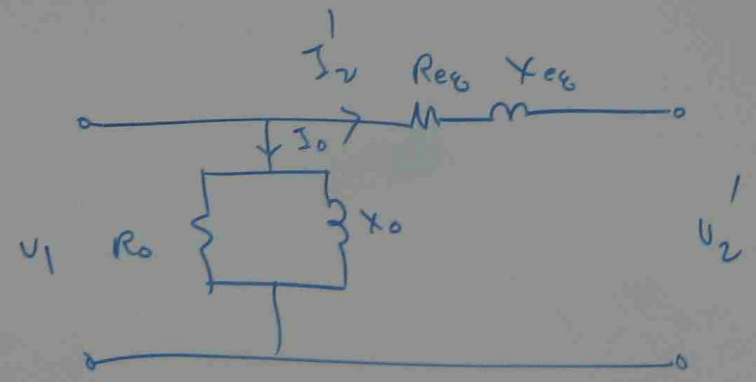
AT MAXIMUM EFFICIENCY

OPEN CIRCUIT POWER LOSS = SHORT CIRCUIT POWER LOSS
(IRON LOSS) (COPPER LOSS)

$$P_{oc} = L^2 P_{sc}$$

$$\therefore L = \sqrt{\frac{P_{oc}}{P_{sc}}}$$

Q5

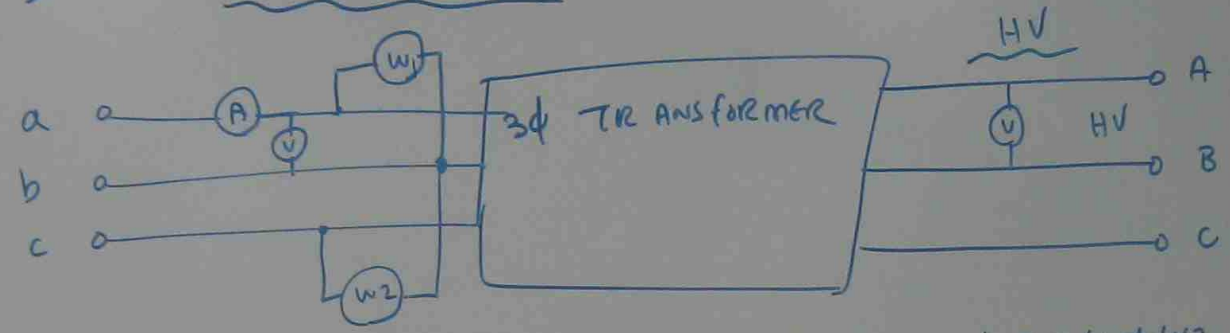


$$R_{1\,eq} = (R_1 + R_2') \quad , R_2' = R_2 \left(\frac{N_1}{N_2}\right)^2$$

$$X_{1\,eq} = (X_1 + X_2') \quad , X_2' = X_2 \left(\frac{N_1}{N_2}\right)^2$$

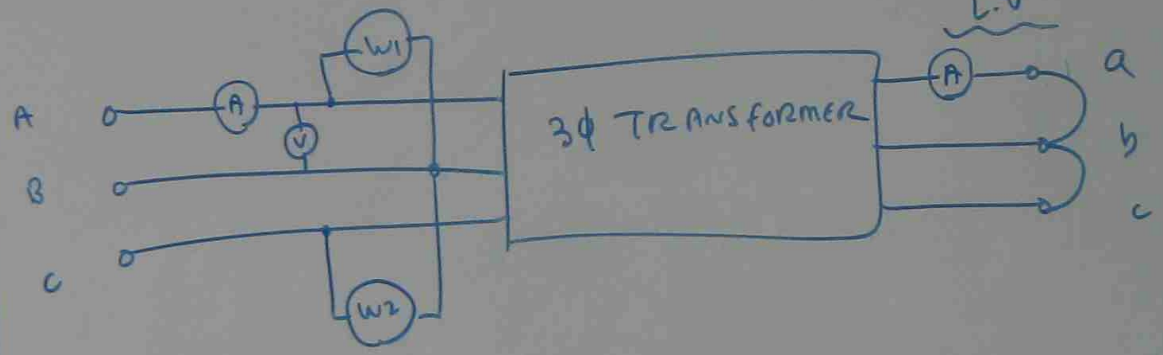
Q6

NO LOAD TEST



SUPPLY AT L.V

$W_T = W_1 + W_2$



SUPPLY AT H.V

Q7

THE EXCITATION CURRENT MEASURED ON THE L.V SIDE of 500 KVA Δ/Y 11 KV/415 V TRANSFORMER IS 12 Amp. IT'S EQUIVALENT IMPEDANCE/PHASE REFERRED TO H.V SIDE IS $4.8 + j32\Omega$.

(a) EXPRESS THE EXCITATION CURRENT/UNIT ON BOTH HV/L.V SIDES OF TRANSFORMER

(b) EXPRESS THE EQUIVALENT IMPEDANCE/UNIT ON HV & L.V SIDES OF TRANSFORMER.

HV SIDE LOAD CURRENT $(I) = \dfrac{500 \times 10^3}{\sqrt{3} \times 11 \times 10^3} = 26.2$ Amp LINE

L.V SIDE LOAD CURRENT $(I) = \dfrac{500 \times 10^3}{\sqrt{3} \times 415} = 696$ Amp LINE

$a = \dfrac{V_{1(Ph)}}{V_{2(Ph)}} = \dfrac{11000}{415/\sqrt{3}} = 45.8$

$Z_1 = a^2 Z_2$

$4.8 + j32 = (45.8)^2 Z_2$

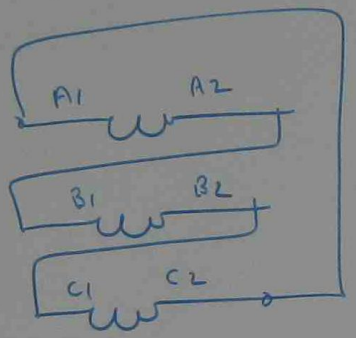
$Z_2 = \dfrac{4.8 + j32}{(45.8)^2} =$

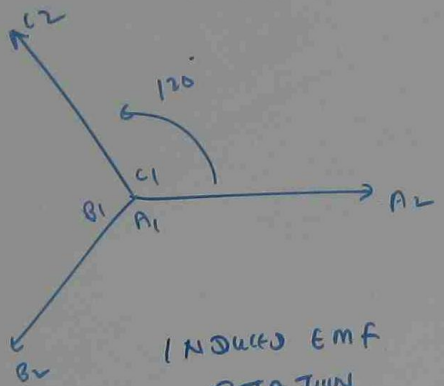
Q8

SKETCH THE FOLLOWING WINDING CONNECTIONS AND THEIR ASSOCIATED VOLTAGE PHASOR DIAGRAM FOR

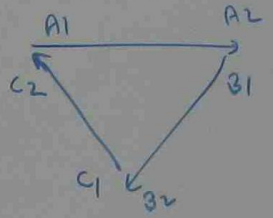
(i) DELTA (ii) STAR.

(i) DELTA

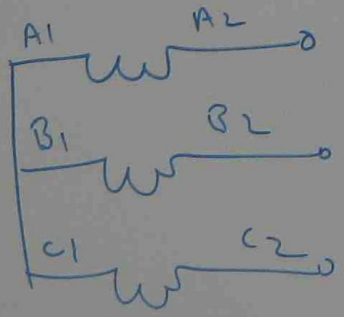


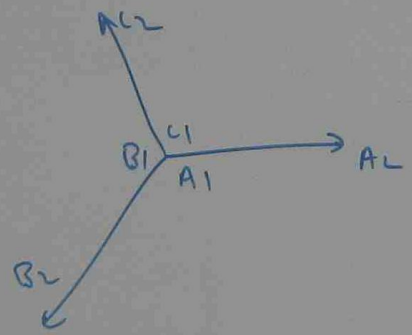


INDUCED EMF ROTATION

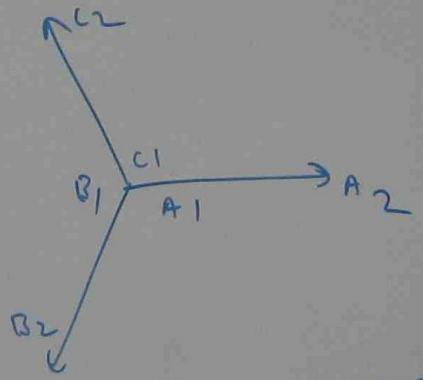


VOLTAGE PHASOR DIAGRAM





INDUCED EMF ROTATION



VOLTAGE PHASOR DIAGRAM

Q9 LIST THE FACTORS THAT ARE REQUIRED FOR SATISFACTORY PARALLEL OPERATION OF TRANSFORMERS.

(a) SAME VOLTAGE RATIO

(b) SAME PERCENTAGE IMPEDANCE

(c) SAME POLARITY

(d) SAME PHASE SEQUENCE

(e) SAME INHERENT PHASE ANGLE DIFFERENCE BETWEEN PRIMARY AND SECONDARY TERMINALS.

Q10 10 MVA, Δ Δ 33KV/11KV

OCT

LINE VOLTAGE = 11 KV

LINE CURRENT = 15 AMP

POWER = 75 KW

SCT

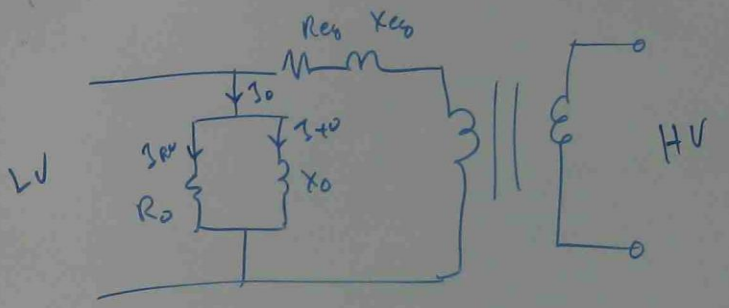
LINE VOLTAGE = 1650V

LINE CURRENT = RATED

POWER = 90 KW

FIND CORE AND WINDING RESISTANCE & INDUCTIVE REACTANCE.

OCT - NO LOAD TEST



$$E = \frac{11\,KV}{\sqrt{3}} = 6350\,V$$

$$I_{L\,ph} = 15\,Amp. = I_o$$

POWER = 75 KW

3φ

$$\text{POWER } 1\phi = \frac{75}{3} = 25\,KW$$

$$R_o = \frac{U_o^2}{\text{power}} = \frac{6350^2}{25\times10^3} = 1613\,\Omega$$

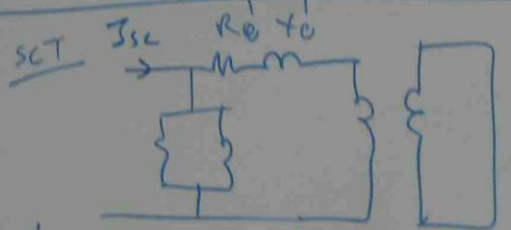
$$I''_{Ro} = \frac{V}{R''_o} = \frac{6350}{1613} = 3.94 \text{ Amp}$$

$$I''_{xo} = \sqrt{(I''_o)^2 - (I''_{Ro})^2}$$

$$= \sqrt{15^2 - 3.94^2} = 14.47 \text{ Amp.}$$

$$X''_o = \frac{V_o}{I''_{xo}} = \frac{6350}{14.47} = 438.8\ \Omega$$

SCT



$$I'_{sc} = I_{Rated} = \frac{10 \times 10^6}{\sqrt{3} \times 33 \times 10^3} = 175 \text{ Amp}$$

$$3(I'_{sc})^2 \times R'_e = 90 \times 10^3$$

$$3(175)^2 \times R'_e = 90 \times 10^3 \Rightarrow R'_e = 0.98\Omega$$

$$V_{sc} = \frac{1650}{\sqrt{3}} = 952\text{V}$$

$$Z'_e = \frac{V_{sc}}{I'_{sc}} = \frac{952}{175} = 5.42\Omega$$

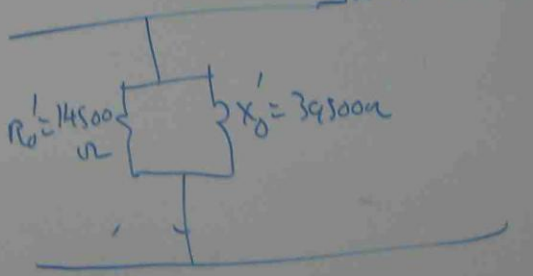
$$X'_e = \sqrt{(Z'_e)^2 - (R'_e)^2}$$

$$= \sqrt{5.42^2 - 0.98^2} = 5.3\Omega$$

$$R'_o = a^2 R''_o = \left(\frac{33/\sqrt{3}}{11/\sqrt{3}}\right)^2 \times 1613 = 14500\Omega$$

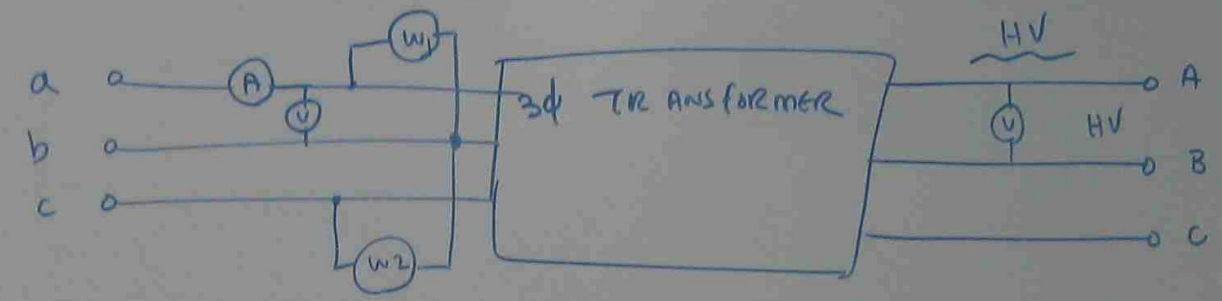
$$X'_o = a^2 X''_o = \left(\frac{33/\sqrt{3}}{11/\sqrt{3}}\right)^2 \times 438.8 = 3945\Omega$$

$R'_e = 0.98\Omega$ $X'_e = 5.3\Omega$



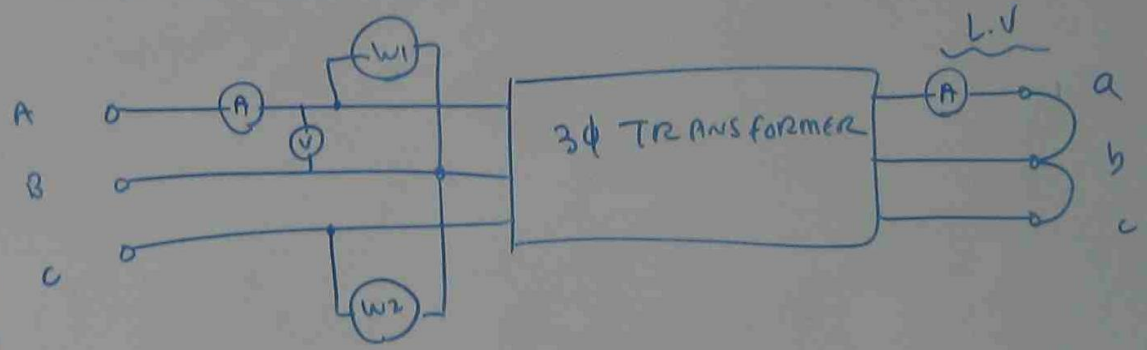
Q6

NO LOAD TEST



SUPPLY AT L.V

$W_T = W_1 + W_2$



SUPPLY AT H.V

5.3Ω

Q11 DESCRIBE THE PRINCIPLE METHODS USED TO COOL LARGE 3ϕ TRANSFORMERS AND THE REASONS FOR THEIR USE.

Q12 DESCRIBE THE MEANINGS OF THE FOLLOWING VECTOR SYMBOLS

(i) D Z0 (ii) Z d6 (iii) Dy$_1$ (iv) Y z 11

Q13 500 V / 250 V 1ϕ TRANSFORMER RATED 10 KVA.

DIAGRAM FOR AUTO TRANSFORMER = 750 / 250 V

CALCULATE THE RATING of AUTO TRANSFORMER

Q11 NATURAL AIR COOLING IS INSUFFICIENT FOR LARGE POWER TRANSFORMERS.

FORCED AIR (OR) FORCED OIL COOLING SYSTEMS ARE TO BE UTILIZED.

AS THE COPPER WINDINGS of TRANSFORMER PRODUCED A LOT of COPPER LOSSES HEAT, IT CAN DOWN GRADE THE INSULATION RESISTANCE OF TRANSFORMER WINDINGS.

BY PROVIDING THE COOLING SYSTEM, TRANSFORMER LIFE CAN BE LONGER.

Q12

D Z 0

PRIMARY Δ — SECONDARY ZIG ZAG — PHASE DISPLACEMENT 0

Z d 6

PRIMARY ZIG ZAG — SECONDARY DELTA — PHASE DISPLACEMENT 6 o'clock (180°)

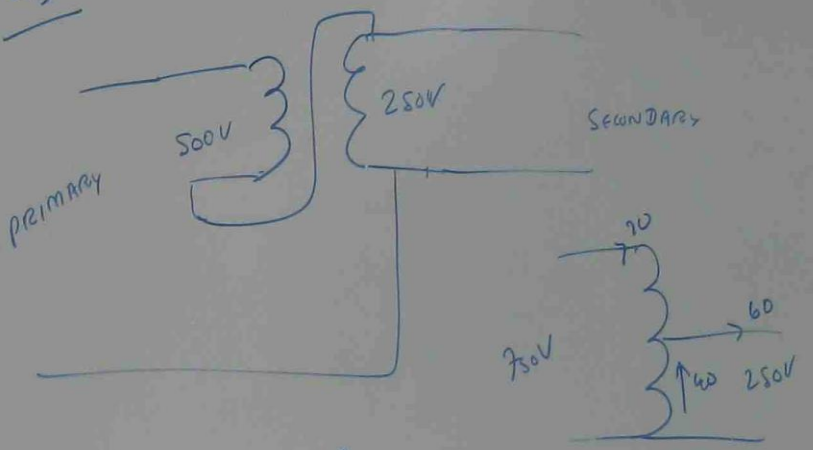
D y 1

PRIMARY DELTA — SECONDARY STAR — PHASE DISPLACEMENT 1 o'clock (OR) −30°

Y Z 11

PRIMARY STAR — SECONDARY ZIG ZAG — PHASE DISPLACEMENT 11 o'clock (OR) +30°

Q13



$$I_{PRI} = \frac{10\,KVA}{500V} = \frac{10\times10^3}{500} = 20A$$

$$I_{Sec} = \frac{10\,KVA}{250V} = \frac{10\times10^3}{250} = 40A$$

$$k = \frac{750}{250} = 3$$

$$\text{Auto TR power} = \left(1-\frac{1}{k}\right) 2\,\text{WDG TR power}$$

$$= \left(1-\frac{1}{3}\right)\times 10$$

$$= 0.667\times10$$

$$= 6.67\,KVA$$

Q14 LIST THE REQUIREMENT OF THE OIL IN OIL IMMERSED TRANSFORMER

Q15 LIST THE IMPORTANT CHARACTERISTICS OF OIL IN OIL TESTING.

Q16 WHICH TRANSFORMER CAN CARRY HARMONICS?

$\lambda\Delta$, $\lambda\lambda$ WITH NEUTRAL, $\lambda\lambda$ WITHOUT NEUTRAL

Q17 WHAT ARE THE DISADVANTAGE OF HARMONICS ?

Q18 EXPLAIN THE EFFECT OF DELTA CONNECTION ON THIRD HARMONICS

Q19 EXPLAIN THE EFFECT OF CORE TYPE & SHELL TYPE CIRCUITS ON THIRD HARMONICS

Q20 DESCRIBE THE FACTORS WHICH GOVERN THE TRANSPORTATION OF LARGE POWER TRANSFORMERS.

Q14 LOW VISCOSITY, HIGH FLASH POINT, LOW ACIDITY
SATISFACTORY INSULATOR

Q15 ELECTRIC STRENGTH, WATER CONTENT, LOSS TANGENT,
RESISTIVITY, ACIDITY, SLUDGE, FLASH POINT

Q16 $\lambda\Delta$ – HARMONIC CURRENT CAN CIRCULATE IN Δ

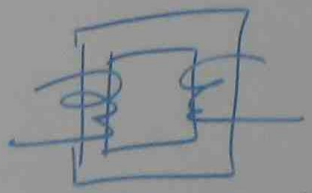
$\lambda\lambda$ WITH NEUTRAL – HARMONIC CURRENT CAN BE TAKEN AWAY BY NEUTRAL

$\lambda\lambda$ WITHOUT NEUTRAL – HARMONIC CURRENT CAN NOT BE TAKEN AWAY. IT WILL COMBINE WITH LINE VOLTAGES AND LINE VOLTAGES WILL BE DISTORTED.

Q17 LINE VOLTAGE WAVE FORM IS DISTORTED.
POWER LOSS IS HIGHER
TRANSFORMER INSULATION DIELECTRIC STRENGTH
IS DOWN GRADED.

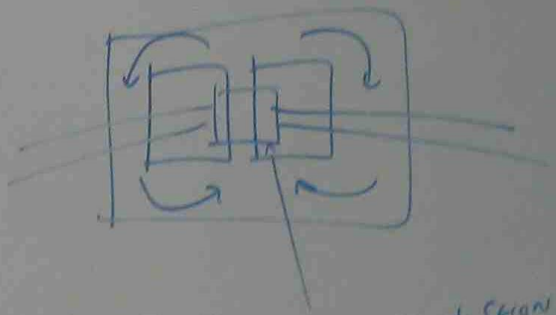
Q18 NO HARMONIC CURRENT EXISTS IN LINE BUT IT EXISTS IN PHASES.

Q19



CORE TYPE

NO HARMONIC RETURN PATH



SHELL TYPE PRIMARY + SECONDARY

HARMONIC CURRENT CAN BE TAKEN AWAY BY OUTER LIMBS

Q20 TRANSFORMER WEIGHT, THE STRENGTH OF ROADS, STRENGTH OF BRIDGE, THE HEIGHT OF TUNNELS ARE TO BE CONSIDERED.

INSTEAD OF TRANSPORTING THE BIG UNIT, SMALL UNITS ARE TO BE TRANSPORTED AND THEN PARALLEL CONNECTION IS TO BE MADE.

Q11 DESCRIBE THE PRINCIPLE METHODS USED TO COOL LARGE 3ϕ TRANSFORMERS AND THE REASONS FOR THEIR USE.

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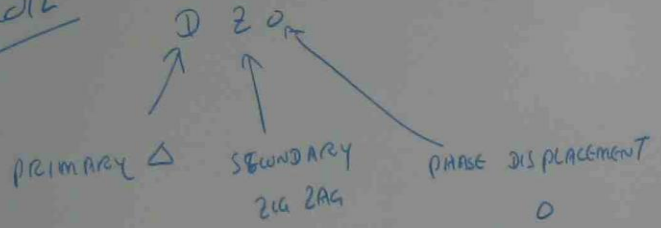
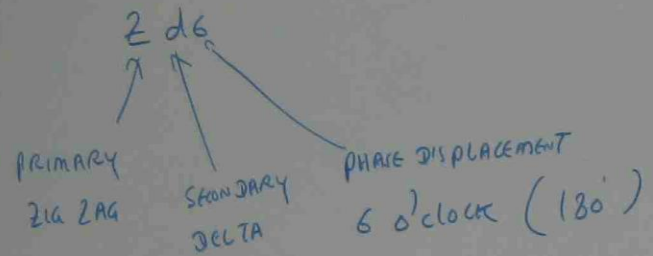
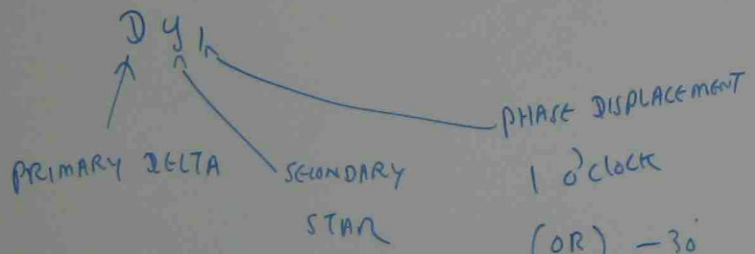
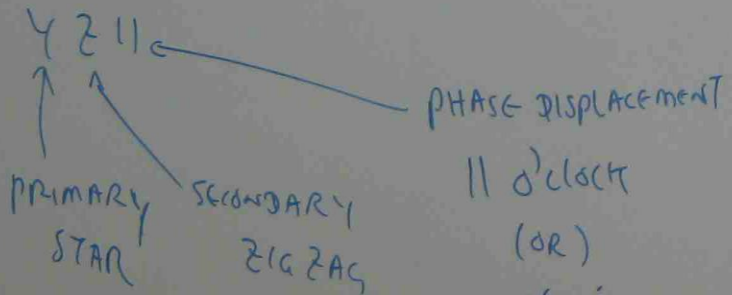
Q12

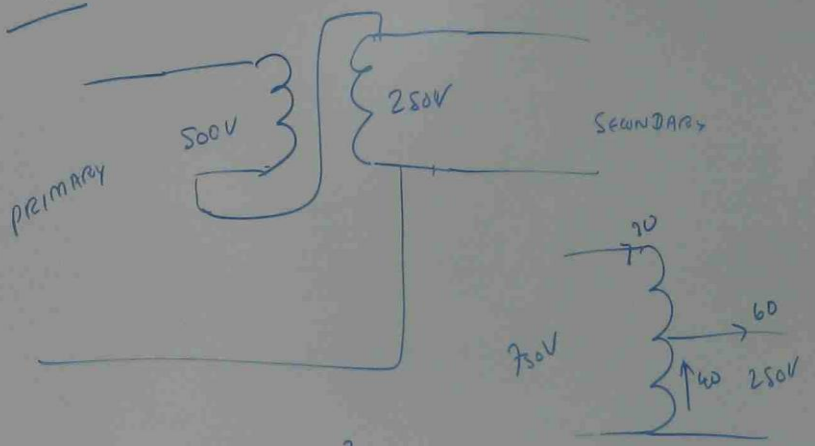








Q13



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