www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupddtes.in

TRANSFORMER

Unit-3

Transformer : Transformer is a static device which transfer electrical energy from one circuit to another circuit without changing frequceny is known as transformer.

During the transform electrical energy the voltage level will increase and current level will decrease overall voltage value will be ~~increase~~ decrease and current value increase.

Construction and working principle of transformer

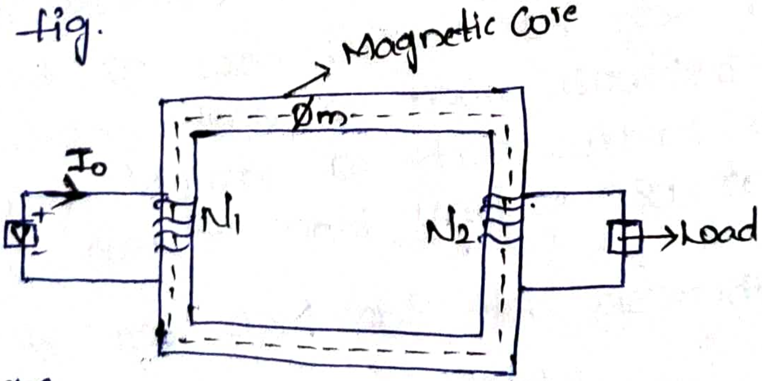
The working principle of transformer is based on mutual induction b/w two couple coils according to electro magnetic induction.

→ According to principle the rate of change of flux with respect to time is equal to induced emf of each coil across "N" turns

$$\boxed{E = N\frac{d\phi}{dt}}$$

→ fig

→ Signal phase transformer in the circuit shown in fig.



Where

1) N_1 = no. of turns primary winding
2) N_2 = no of terms secondary winding
3) ϕ_M = Magnetic flux
4) V = Supply voltage (or) Input voltage
5) I = Primary current
6)

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

→ Signal phase transformers are consisting of two winding.

i) primary winding ii) Secondary winding.

→ The winding with "N_1" no. of terms is ~~equ~~ called Primary winding and winding with "N_2" no. of terms is called Secondary winding.

→ The energy transfer from one circuit to another circuit is take place with help of electro magnetic induction.

→ The current flowing in primary winding the magnetic flux will be produced.

→ The primary winding connected to the Ac supply which are input ~~value~~ voltage is taken.

→ The Secondary winding of flux linkage (or) mutual flux the induced emf will be produced.

→ The magnitude frequency completely in dependence upon secondary winding.

→ The induced emf of secondary winding can be delicver the power to any load across

→ The induced emf of secondary winding the load will be open circuit that is induced emf is equal to terminal voltage.

→ Depends upon the connection of winding classification of transformer two types.

1) ~~to~~ core type transformer.

2) Shell type transformer.

→ Depending upon connection of voltage classification of transformer two types.

i) Step up transformer

ii) Step down transformer

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

→ construction of the signal phase transformer
they are no moving parts.

→ construction of the transformer divided into Nine parts.

1) Radiators.
2) Magnetic core
3) Winding
4) constructive tank
5) Breathers
6) Brushing
7) Transformer oil
8) Container
9) Buchholz relay

Difference b/w step up & step down transformer.

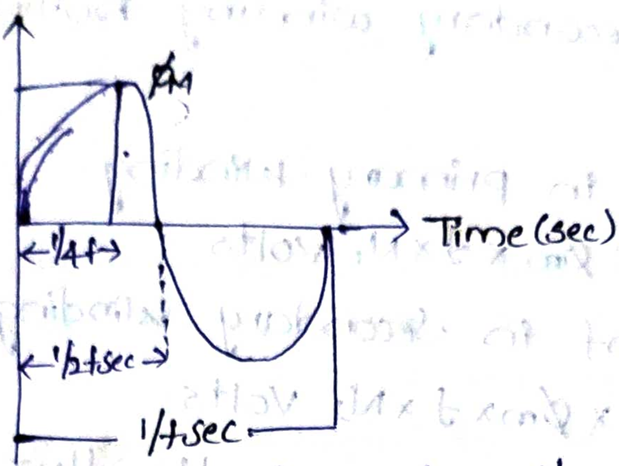
step-up transformer	step-down transformer
i) Secondary terminal voltage is greater than primary terminal voltage $\boxed{V_s > V_p}$	Secondary terminal voltage is less than primary terminal voltage $\boxed{V_s < V_p}$
ii) No. of terms in secondary winding greater than no. of terms in primary winding $\boxed{N_s > N_p}$	No. of terms in secondary winding less than no. of terms in primary winding $\boxed{N_s < N_p}$
iii) Secondary current is less than primary current $I_s < I_p$	Secondary current greater than primary current $I_s > I_p$
step up transformer used in electrical transmition system.	step ~~up~~ down transformer in electrical distribution system

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

E.M.F Equation of Transformer.

Let consider alternating fluxe by voltage source in Sinusoidol wave form shown in fig



In above wave form in alternating fluxe will be max the time period 1/4 f sec.

⇒ By electro magnetic induction

$$E = N \frac{d\phi}{dt}$$

Hence change in fluxe $d\phi = \phi_M$ (Weber)

$dt = 1/4f$ sec

The average induced emf is given as

$$E_{avg} = N \frac{\phi_M}{1/4f}$$

$$\boxed{E_{avg} = 4 \phi_M f N \text{ volts}}$$

Since the fluxe value is sinusoidol wave form.

⇒ The formfactor of Sinusoidal fluxe value will be constant $\boxed{1.11}$

⇒ formfactor defined as the ratio RMS value to average value.

$$\boxed{\text{form factor} = \frac{\text{RMS Value}}{\text{Average value}}}$$

⇒ The RMS induced emf is given as

E_{rms} = form factor × Average value

$E_{rms} = 1.11 \times \phi_M \times f \times N$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$\boxed{E_{rms} = 4.44 \phi_M \times f \times N}$$

If E_1 and E_2 RMS value of induced emf in Primary and secondary winding having N_1 and N_2 respectively.

Induced Emf in primary winding

$E_1 = 4.44 \times \phi_m \times f \times N_1$ volts

Induced Emf in secondary winding

$E_2 = 4.44 \times \phi_m \times f \times N_2$ Volts.

⇒ Where maximum magnetic flux

$$B = \frac{\phi_M}{A} \text{ (Telsa) (or) } \frac{\text{Weber}}{m^2}$$

$\phi_M = B \times A$

Where B = Magnetic flux density.

units: Telsa (or) Weber/m^2

A = Area of cross section

Units: M^2

Substitute the ϕ_m value

$$\boxed{E_1 = 4.44 \times B \times A \times f \times N_1 \text{ volts}}$$

Similarly

$$\boxed{E_2 = 4.44 \times B \times A \times f \times N_2 \text{ Volts}}$$

*** Voltage Ratio of Transformer

The Ratio of induced emf in Secondary winding to induced emf in primary winding is known as voltage ratio of transformer.

It is denoted by "K".

$$K = \frac{\text{Induced emf in Secondary winding}}{\text{Induced emf in Primary winding}} = \frac{E_2}{E_1}$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$K = \frac{\cancel{4.44}\,\cancel{\phi_m} \times \cancel{f} \times N_2}{\cancel{4.44} \times \cancel{\phi_m} \times \cancel{f} \times N_1}$$

$$\boxed{K = \frac{N_2}{N_1}}$$

$$\boxed{K = \frac{E_2}{E_1} = \frac{N_2}{N_1}}$$

Q) In a single phase transformer 50H has 80 turns in the primary winding 400 turns in secondary winding the area of cross section of the core $200\ cm^2$. if the primary winding connected to 240 V. Determine the

i) The induced emf in secondary winding.

ii) Maximum flux density of the core in primary winding

Given data

frequency $f = 50\ H$

No. of turns in primary winding $(N_1) = 80$

No. of turns in secondary winding $(N_2) = 400$

Area of cross section $A = 200\ cm^2$

$= 200 \times 10^{-4}\ m^2$

$= 2 \times 10^{-2}\ m^2$

Induced emf in primary $(E_1) = 240$

i) $E_2 = ?$

ii) $B = ?$ in primary

$$K = \frac{E_2}{E_1} = \frac{N_2}{N_1}$$

$$K = \frac{N_2}{N_1} = \frac{400}{80}$$

$$\boxed{K = 5}$$

$$K = \frac{E_2}{E_1} \Rightarrow E_2 = K \times E_1 = 5 \times 240$$

$$\boxed{E_2 = 1200V}$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$E_1 = 4.44 \times B \times A \times f \times N_1$

$240 = 4.44 \times B \times 2 \times 10^{-2} \times 50 \times 80$

$$B = \frac{240}{4.44 \times 2 \times 10^{-2} \times 50 \times 80}$$

$$\boxed{B = 0.67 \text{ Telsa } wb/m^2}$$

Result:

i) $E_2 = 1200V$

ii) $B = 0.67$ Telsa

Q) In a Single phase transformer 50H. 200 turns in the primary winding and 800 turns in Secondary winding the area of cross section is $24\ cm^2$. It the secondary winding connected to 400V. determine the

i) The induced emf in the primary winding.

ii) The maximum flux density in secondary winding.

Sol: Given data.

frequency $f = 50Hz$

No. of turns in primary winding $(N_1) = 200$

No. of turns in Secondary winding $(N_2) = 800$

Area of cross Section $A = 24\ cm^2$
$= 24 \times 10^{-4}\ m^2$

~~Induced emf in Primary $E_1 = ?$~~

Induced emf in Secondary $E_2 = 400$

i) $E_1 = ?$

ii) $B = ?$ Secondary.

$$K = \frac{E_2}{E_1} = \frac{N_2}{N_1}$$

$$K = \frac{N_2}{N_1} = \frac{800}{200}$$

$$\boxed{K = 4}$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$K = \frac{E_2}{E_1} \rightarrow E_2 = K \times E_1$
$= 4 \times$

$4 = \frac{400}{E_1}$

$E_1 = \frac{400}{4}$

$\boxed{E_1 = 100V}$

$E_2 = 4.44 \times B \times A \times f \times N_2$

$400 = 4.44 \times B \times 24 \times 10^{-4} \times 50 \times 800$

$B = \frac{400}{4.44 \times 24 \times 10^{-4} \times 50 \times 800}$

$\boxed{B = 0.93 \text{ Telsa} \cdot Wb/m^2}$

Result:

i) $E_1 = 100V$

ii) $B = 0.93$ Telsa.

Q) $\frac{3300}{230}$ V, 50H single phase transformer is to be work at maximum fluxe density 1.2 Telsa in the core is 150 cm². calculate the value of primary & secondary turns.

Sol: Given data

frequency $f = 50H$.

Induced emf in primary winding $(E_1) = 3300$

Induced emf in Secondary winding $(E_2) = 50$

Area of cross section $A = 150 \, cm^2$
$= 150 \times 10^{-4} m^2$
$= 15 \times 10^{-3} m^2$

Maximum flux density $(\phi m) = 1.2$ Telsa.

$E_1 = ?$

$E_2 = ?$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$K = \frac{E_2}{E_1}$$

$$= \frac{230}{3300}$$

$$\boxed{K = 0.06}$$

$$E_1 = 4.44 \times B \times A \times f \times N_1$$

$$3300 = 4.44 \times 1.2 \times 150 \times 10^{-4} \times 50 \times N_1$$

$$N_1 = \frac{3300}{4.44 \times 1.2 \times 150 \times 10^{-4} \times 50}$$

$$\boxed{N_1 = 826}$$

$$K = \frac{E_2}{E_1}$$

$$K = \frac{N_2}{N_1}$$

$$N_2 = K \times N_1$$

$$N_2 = 0.06 \times 826$$

$$\boxed{N_2 = 57}$$

Q) 6300/210 V, 50H in single phase transformer has for turns induced emf 9V and the maximum flux density 1.2 W/m². find the number of high voltage and low voltage turns and area of cross section of the Core.

Sol: Given data

$E_1 = 6300V$

$E_2 = 210V$

$f = 50H$

$B = 1.2\ Wb/m^2$

Induced emf per each turn = 9V

i) High voltage then $N_1 = ?$

ii) Low voltage then $N_2 = ?$

iii) $A = ?$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

High voltage then $N_1 = \dfrac{\text{Primary voltage}(E_1)}{\text{Induced emf each turn}}$

$= \dfrac{6300}{9}$

$\boxed{N_1 = 700}$

|||y $N_2 = \dfrac{\text{Secondary voltage}(E_2)}{\text{Induced emf each turn}}$

$N_2 = \dfrac{210}{9}$

$= 23.3$

$\boxed{N_2 = 23}$

$E_1 = 4.44 \times B \times f \times A \times N_1$

$6300 = 4.44 \times 1.2 \times A \times 50 \times 700$

$A = \dfrac{6300}{4.44 \times 1.2 \times 50 \times 700}$

$\boxed{A = 0.03\ m^2}$

Q) 25 KVA (power) single phase transformer has 250 turns in the primary and 40 turns in secondary winding the primary winding connected to 1500 V and 50 H. calculate the

i) Secondary induced emf

ii) Primary and secondary current

iii) Maximum flux of the core

Sol: Given data

Rating of transformer = 25 KVA

No. of turns in primary $N_1 = 250$

No. of turns in secondary $N_2 = 40$

$E_1 = 1500V$

$f = 50HZ$

i) $E_2 = ?$

ii) $I_1 = ?$ $I_2 = ?$

iii) $\phi_M = ?$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$K = \frac{E_2}{E_1} = \frac{N_2}{N_1}$$

i) $K = \frac{N_2}{N_1} = \frac{40}{250}$

$$\boxed{K = 0.16}$$

$K = \frac{E_2}{E_1} \Rightarrow E_2 = K \times E_1$

$= 0.16 \times 1500$

$$\boxed{E_2 = 240V}$$

ii) $I_1 = \frac{\text{KVA rating}}{\text{Primary voltage}}$

$VI = P$

$I = \frac{P}{V}$

$I_1 = \frac{P}{V_1}$

$I_1 = \frac{25 \times 10^3}{1500}$

$$\boxed{I_1 = 16.66 A}$$

$K = \frac{I_1}{I_2}$

$I_2 = \frac{I_1}{K} \Rightarrow \frac{16.66}{0.16}$

$$\boxed{I_2 = 104.12 A}$$

iii) $\phi_m = ?$

$E_1 = 4.44 \times \phi_m \times f \times N_1$

$1500 = 4.44 \times \phi_m \times 50 \times 250$

$\phi_m = \frac{1500}{4.44 \times 50 \times 250}$

$$\boxed{\phi_m = 0.02 \text{ wb}}$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Differences between Ideal and Practical Transformer.

Ideal	Practical
i) Ideal transformer has no looses.	i) Practical transformer including in copper and Iron looses.
ii) The appiled voltage in Primary winding is equal to induced emf voltage Primary winding. $\boxed{E_1 = V_1}$	ii) The appiled voltage in Primary winding is not equal to induced emf voltage in primary winding $\boxed{E_1 \neq V_1}$
iii) The winding resistance of the transformer is equal to zero	iii) The winding resistance of the transformer is equal to definite value
iv) The induced emf in Secondary voltage is equal to load voltage.	iv) The induced emf in Secondary voltage is not equal to load voltage
v) There is no voltage drop in type of transformer	v) There is voltage drop is exist
vi) There is no leakage reactance	vi) There is leakage reactance exist
vii) There is no magnetic flux	vii) There is magnetic flux exist
viii) To developed the flux in the core there is no current required in this type of transformer.	viii) To develop the flux in the core magnetising current is required in this type of transformer
ix) The total flux in primary winding link with Secondary winding	ix) The total flux in primary winding don't link with Secondary winding

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Losses of Transformer:

The losses of transformer are classified into two types.

i) Copper looses
ii) Iron/core losses.

i) Copper losses: The copper looses occurs the winding resistance of the transformer appears has heat result in increasing temperature.

If I_1, I_2 primary and secondary current
R_1, R_2 primary and secondary resistance respectively.

The copper losses in primary winding $I_1^2R_1$
The copper losses in secondary winding $I_2^2R_2$
The copper losses of the transformer is given as $\boxed{I_1^2R_1 + I_2^2R_2}$

ii) Iron/core losses:
The Iron looses occurs alternating flux and also classified into two types.
i) Hystensis looses
ii) Eddy current looses.

i) Hystensis losses:
The hystensis looses occurs due to continous magnestation and Dimagensitation every cycle of alternating flux

→ The hystensis looses appears on the resulting in increasing in temperature

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

⇒ The Hystensis looses can't be eliminated However the can be minimize which passes low hystensis coefficient

⇒ The Hystensis looses is given as

$$\boxed{P_{hys} = K_{hys}\, B_M^x\, V f}$$ units : Watts

Where K_{hys} = Constant

B_M^x = Maximum flux density

V = ~~value~~ Volume of the magnetic core

f = frequency

x = The value is varies from 1.2 to 1.6

Eddy current losses:

The Eddy current losses occurs alternating flux to the core the induced emf an passing through circulating current is known as Eddy current losses.

⇒ This type of losses depending upon length of the resistance.

⇒ The eddy current looses reduced by using thickness of lamination to the core material

⇒ This type of losses also can't be eliminated.

⇒ By using lamination the effective resistance to eddy current value will be increased an circulating current will be decreased.

⇒ The Eddy current losses is given as

$$\boxed{P_{eddy} = \frac{K_{eddy}\, B_M^2 f^2 t^2}{\rho}}$$

Where ρ = Resitivity of the material

t = thickness of the limination of the core

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Kedly = Constant

Efficiency of Transformer.

efficency of transformer it is defined as the ratio of output power to input power is known as Efficency.

→ The outpower is less than input power due to losses in transformer.

The mathematical efficiency is given as

$$\boxed{\eta = \frac{\text{output power}}{\text{Input power}}}$$

$$\boxed{\% \eta = \frac{\text{output power}}{\text{Input power}} \times 100}$$

Based on the above equation the effiency of transformer is given as

$$\text{output power} = \text{Input power} - (\text{Total losses})$$

$$\text{output power} = I/P - (P_{cu} + P_{iron})$$

$$I/P = \text{output power} + (P_{iron} + P_{cu})$$

$$\eta = \frac{\text{Input power} - (P_{iron} + P_{cu})}{\text{Input}}$$

$$\boxed{\% \eta = \frac{\text{Input power} - (P_{iron} + P_{cu})}{\text{Inputpower}} \times 100}$$

Voltage regulation:

It is defined as the ratio of difference between Secondary terminal voltage no load and Secondary terminal voltage full load to Second terminal no load is known as voltage regulation.

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

The voltage regulation is known as

$$\boxed{\% R = \frac{E_2 - V_2}{E_2} \times 100}$$

where

E_2 = Secondary terminal voltage no load

V_2 = Secondary terminal voltage full load.

Condition for Maximum efficiency.

The efficiency of transformer said to be maximum when it is copper losses to Iron losses.

$$\boxed{P_{cu} = P_{iron}}$$

The copper losses in Secondary winding $= I_2^2 R_2$

We know that,

$$\boxed{P_{iron} = P_{hys} + P_{eddy}}$$

Let consider Input power $= V I_2 \cos\phi$

the efficiency of transformer is given as

$$\eta = \frac{\text{output power}}{\text{Input power}}$$

output = Input power − (Total losses) $(P_{cu} + P_{iron})$

$V I_2 \cos\phi - (I_2^2 R_2 + P_{iron})$

Output $= V I_2 \cos\phi - I_2^2 R_2 - P_{iron})$

$$\eta = \frac{V I_2 \cos\phi - I_2^2 R_2 - P_{iron}}{V I_2 \cos\phi}$$

$$\eta = 1 - \frac{I_2^2 R_2}{V I_2 \cos\phi} - \frac{P_{iron}}{V I_2 \cos\phi}$$

$$\eta = 1 - \frac{I_2 R_2}{V \cos\phi} + \frac{P_{iron}}{V I_2 \cos\phi}$$

diff w.r.to I_2 $\left(\because d\left(\frac{1}{x}\right) = \frac{-1}{x^2}\right)$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$\frac{dx}{dI_2} = 0 - \frac{(1)R_2}{V\cos\phi} + \frac{P_{iron}}{VI_2^2\cos\phi}$$

$$\frac{dx}{dI_2} = \frac{-R_2}{V\cos\phi} + \frac{P_{iron}}{VI_2^2\cos\phi}$$

The maximum efficiency of transformer equivent to zero

$$\frac{dx}{dI_2} = 0$$

$$\frac{-R_2}{V\cos\phi} + \frac{P_{iron}}{VI_2^2\cos\phi} = 0$$

$$\frac{P_{iron}}{\cancel{V}I_2^2\cancel{\cos\phi}} = \frac{R_2}{\cancel{V\cos\phi}}$$

$$\frac{P_{iron}}{I_2^2} = R_2$$

$$\boxed{P_{iron} = I_2^2 R_2}$$

Hence the verification is proved

$$\boxed{I_2^2 = \frac{P_{iron}}{R_2} \Rightarrow I_2 = \sqrt{\frac{P_{iron}}{R_2}}}$$

Q) The no load current of transformer is 10 Amp at the power factor of 0.25 laging ~~power factor~~ when connected through 400V & 50HZ apply calculate the magnitisation current component of no load current, iron losses and the maximum value of flux if the core consider primary winding terms has 500 turns.

Given data

load current $I_0 = 10A = I_1$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$\cos\phi = 0.25$

$f = 50HZ$

$V_1 = 400V$

No of turns $N_1 = 500$

i) $I_M = ?$

ii) Iron losses

iii) $\phi_M = ?$

i) $I_M = I_0 \sin\phi$

$\cos\phi = 0.25$

$\phi = \cos^{-1}(0.25)$

$\phi = 75.52$

$I_m = 10 \times \sin(75.52)$

$\boxed{I_m = 9.68 A}$

ii) Iron losses no load current $= V_1 I_1 \cos\phi$

$= 400 \times 10 \times 0.25$

$\boxed{P_{iron} = 1000W}$

iii) $E_1 = 4.44 \times \phi m \times f \times N_1$

$400 = 4.44 \times \phi m \times 50 \times 500$

$\phi m = \frac{400}{4.44 \times 50 \times 500}$

$\phi m = 3.603 \times 10^{-3}$ wb

$\phi m = \frac{3.603}{1000}$

$\boxed{\phi m = 0.0036 \text{ wb}}$

Q) The no load current of transformer is 20 Amp at the power factor of 0.8 laging when connected through 600V & 50HZ supply calculate the maginastion current component of no load current, iron losses and max density of flux of core consider primary winding turns has 400 area of cross section 20 cm^2

Given data

load current $I_0 = 20A = I_1$

$\cos\phi = 0.8$

$f = 50HZ$

$V_1 = 600V$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

No. of turns $N_1 = 400$

Area of cross section $= 20 \times 10^{-2}$
$= 20 \times 10^{-4} m^2$
$= 2 \times 10^{-3} m^2$

i) $I_m = ?$

ii) Iron losses

iii) $B = ?$

$I_M = I_0 \sin\phi$

$\cos\phi = 0.8$

$\phi = \cos^{-1} 0.8$

$\phi = 0.643$

$I_m = 20 \times \sin(0.643)$

$\boxed{I_m = 11.94 A}$

ii) Iron losses no load current $= V_1 I_1 \cos\phi$
$= 600 \times 20 \times 0.8$

$\boxed{P_{iron} = 9600 W}$

$E_1 = 4.44 \times B_M \times A \times f \times N_1$

$600 = 4.44 \times B_M \times 20 \times 10^{-4} \times 50 \times 400$

$$B_M = \frac{600}{4.44 \times 20 \times 10^{-4} \times 50 \times 400}$$

$\boxed{B_M = 3.378 \text{ wb/m}^2 \text{ (or) Telsa}}$

***

Q) 50 KVA, 6,600/220 volts step down transformer of total resistance in secondary winding 0.0211 ohms. calculate of full load copper and efficiency of transformer full load. If the iron losses is equal to copper losses at unity power factor of this load.

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Given data

KVA rating $= 50$ KVA
$= 50 \times 10^3$ A

Primary voltage $= 6600$ V

secondary voltage $= 220$ V

Total resistance in Secondary $R_2 = 0.0211\ \Omega$

$\cos\phi = 1$

$I_2 = ?$

i) $P_{cu} = ?$

ii) $\eta = ?$

full load Secondary current $I_2 = \frac{\text{KVA rating}}{\text{Secondary voltage}}$

$$= \frac{50 \times 10^3}{220}$$

$$= 227.27 \text{ A}$$

The copper losses in Secondary $= I_2^2 \times R_2$

$$= (227.27)^2 \times 0.0211$$

$$\boxed{P_{cu} = 1089.84 \text{ W}}$$

$$\eta = \frac{\text{output}}{\text{Input}}$$

output power $= (\text{Desired load})^2 \times VI\cos\phi$

$$= 1 \times 50 \times 10^3 \times 1$$

$$\boxed{\text{O/P Power} = 50{,}000}$$

Input power $=$ output power $+$ Total losses

Total losses $= P_{iron} + P_{cu}$

$P_{cu} + P_{cu}$

$$\boxed{\text{Total losses} = 2 \times P_{cu}}$$

The copper losses in full load

$(\text{Desired load})^2 \times P_{cu}$ losses

$(1)^2 \times 1089.84$

The full load cu losses $= 1089.84$ W

Total losses $= 2 \times P_{cu}$

$= 2 \times 1089.84$

$= 2179.68$ W

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$\% \eta = \frac{o/p \text{ power}}{\text{Input power}} \times 100$$

$$\% \eta = \frac{50{,}000}{50{,}000 + 2179.68} \times 100$$

$$\boxed{\% \eta = 95.82\%}$$

**
Q) A signal phase transformer, 15 KVA has iron losses 200 W and full load copper losses 300 W. Determine the efficiency of transformer

i) full load, unity power factor (UPF)

ii) 3/4 load UPF

iii) 1/2 load 0.8 power factor.

Given data

KVA rating = 15 KVA = 15×10^3

Iron losses $P_{iron} = 200W$

full-load copper losses, $P_{cu} = 300 W$

calculate efficiency

i) full load upf

ii) 3/4 load, upf

iii) 1/2 load, 0.8 PF

i) $\eta = \frac{\text{output power}}{\text{Input power}}$

output power = (Desired load) × VI cos Ø

= (1) × 15×10^3

= 15000 W

Input power = out put power + Total losses

Total losses = $P_{iron} + P_{cu}$

= 200 + 300

Total losses = 500 W

$$\% \eta = \frac{15000}{15500} \times 100$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$\boxed{\% \eta = 96.7\%}$

) Output power = Desiread load × $VI\cos\phi$

$= (3/4) \times 15 \times 10^3 \times 1$

$= 11250W$

I/p = O/p power + Total losses

copper losses in 3/4 load $P_{cu} = (\text{Desiread load})^2 \times P_{cu}$

$= (3/4)^2 \times 300$

$P_{cu}(3/4) = 168.75W$

Total losses = $P_{iron} + P_{cu\,3/4}$

$= 200 + 118.75$

$= 368.75\ W$

$$\% \eta = \frac{\text{O/P put power}}{\text{I/p put power}} \times 100$$

$$\% \eta = \frac{11250}{11618.7} \times 100$$

$\boxed{\% \eta = 96.8\%}$

) output power = (desired power) $VI\cos\phi$

$= (1/2) \times 15 \times 10^3 \times 0.8$

$= 6000$

I/P = O/P + total losses

copper losses in 1/2 load $\boxed{P_{cu} = (\text{Desired load})^2 \times P_{cu}}$

$= (\frac{1}{2})^2 \times 300$

$= \frac{1}{4} \times 300$

$\boxed{P_{cu} = 750}$

total losses = $P_{cu}(1/2) + P_{iron}$

$= 75 + 200$

$= 275$

I/P = 6000 + 275

$$\eta = \frac{\text{output power}}{\text{Input power}} \times 100$$

$$\% \eta = \frac{6000}{6275} \times 100$$

$\boxed{\% \eta = 95.61}$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Q) A single phase transformer working at UPF efficiency 95% at both half load and full load and rating of transformer 1.5 KVA determine the efficiency of 60% full load.

Given data

The efficiency of full load = 95% = 0.95

The efficiency of half load = 95% = 0.95

KVA rating transformer = 1.5 KVA $= 1.5 \times 10^3$ VA

$\cos\phi = 1$

i) 60% full load efficiency

$$\eta = \frac{\text{output power}}{\text{Input power}}$$

output power = (Desired load) × $VI\cos\phi$

$= (1) \times 15 \times 10^3 \times 1$

outputpower = 1500 W

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

$$I/p \text{ power} = \frac{1500}{0.95}$$

$\boxed{I/p \text{ power} = 1578.94 \text{ W}}$

I/p power = outpower + ($P_{iron} + P_c$)

$P_i + P_c$ = Input − outpower

$= 1578.74 - 1500$

$P_i + P_c = 78.94$ —— ①

$$\eta = \frac{\text{outpower}}{\text{input power}}$$

Output power = (Desired load) × $VI\cos\phi$

$= (1/2) \times 1.5 \times 10^3 \times 1$

$\boxed{\text{output power} = 750 \text{ W}}$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$\text{Input} = \frac{\text{output power}}{\text{efficiency}}$$

$$\text{Input power} = \frac{750}{0.95}$$

$$\boxed{\text{Input power} = 789.47}$$

Total losses $= P_i + P_c$

$$P_{cu\frac{1}{2}} = (\text{Desired load})^2 \times P_{cu}$$
$$= \left(\tfrac{1}{2}\right)^2 \times P_{cu}$$
$$P_{cu} = \frac{P_c}{4}$$

Input power = o/p power + Total losses

$$P_i + \frac{P_c}{4} = I/p - o/p$$

$$\frac{4P_i + P_c}{4} = 789.47 - 750$$

$$\frac{4P_i + P_c}{4} = 39.47$$

$$4P_i + P_c = 157.88 \quad \text{——} \; (2)$$

Solving (1) & (2)

$$P_i + P_c = 78.94$$
$$4P_i + P_c = 157.88$$
$$-3P_i = -78.94$$
$$P_i = \frac{78.94}{3}$$

$$\boxed{P_i = 26.31W}$$

P_i sub in eq (1)

$$26.31 + P_c = 78.94$$
$$P_c = 78.94 - 26.31$$
$$\boxed{P_c = 52.63W}$$

$$\%\,\eta = \frac{\text{o/p power}}{\text{I/p power}} \times 100$$

$$\text{o/p power} = (\text{Desired load}) \times VI\cos\phi$$
$$= (0.6) \times 1.5 \times 10^3 \times 1$$

$$\boxed{\text{o/p Power} = 900W}$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Input = output power + $(P_i + P_c)$

$P_{cu\,60\%}$ = (Desired load)$^2 \times P_{cu}$

$= (0.6)^2 \times 52.63$

$\boxed{P_c = 18.94W}$

I/P = 900 + (26.31 + 18.94)

$\boxed{\text{I/p power} = 945.25\omega}$

$\% \eta = \frac{900}{945.25} \times 100$

$\boxed{\% \eta = 95.21}$

9) A signal phase transformer working at 0.8 power factor the efficiency of 96.8% at both half and full load the KVA. rating of transformer 150 KVA determine the efficiency at 75% full load.

Given

The efficiency of full load = 96.8 = 0.968

The efficiency of half load = 96.8 = 0.968

KVA rating of transformer = 150 KVA

$= 150 \times 10^3$ VA

= 150000 VA

$\cos\phi = 0.8$

i) 75% of full load efficiency

$\eta = \frac{\text{output power}}{\text{Input power}}$

Output power = (Desired load) × $VI\cos\phi$

$= (1) \times 150000 \times 0.8$

output power = 120000W

Input power = $\frac{\text{output power}}{\text{efficiency}}$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$I/P = \frac{120000}{0.968}$$

$$\boxed{I/P\ power = 123966.9}$$

I/P power = O/P power + $(P_{cu} + P_{iron})$

$P_{cu} + P_{iron} = I/P - O/P$

$P_{cu} + P_{iron} = 123966.9 - 120000$

$\boxed{P_{cu} + P_{iron} = 3966.94}$ —— ①

75% of half load of

$$\eta = \frac{\text{output power}}{\text{Input power}}$$

output power = (desired load) × $VI\cos\phi$

$= (1/2) \times 150000 \times 0.8$

$= 60000$

$$\text{Input power} = \frac{\text{output power}}{\text{efficiency}}$$

$$= \frac{60000}{0.968}$$

$\boxed{I/P = 61983.47}$

I/P = outpower + $(P_{cu} + P_{iron})$

$P_{cu} + P_{iron}$ = Input power − output power

$P_{cu} + P_{iron} = 61983.47 - 60000$

$P_{cu} + P_{iron} = 1983.47$

Losses in copper = $(\text{desired load})^2 \times P_{cu}$

$= \left(\frac{1}{2}\right)^2 \times P_{cu}$

$= \frac{P_{cu}}{4}$

$P_{iron} + \frac{P_{cu}}{4} = 1983.47$

$\frac{4P_i + P_{cu}}{4} = 1983.47$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$4P_i + P_{cu} = 4 \times 1983.47$

$4P_i + P_{cu} = 7933.88$ —— ②

solving eq ① & ②

$$P_{ir} + \cancel{P_{cu}} = 3966.94$$
$$4P_{ir} \cancel{+P_{cu}} = 7933.88$$
$$\cancel{-}3P_{iron} = \cancel{-}3966.94$$

$$P_{iron} = \frac{3966.94}{3}$$

$$\boxed{P_{iron} = 1322.31}$$

P_{iron} sub in ①

$P_{iron} + P_{cu} = 3966.94$

$1322.31 + P_{cu} = 3966.94$

$P_{cu} = 3966.94 - 1322.31$

$$\boxed{P_{cu} = 2644.63}$$

$$\% \eta = \frac{\text{output power}}{\text{Input power}} \times 100$$

$O/P = (\text{Desired power})\ VI \cos\phi$

$= (0.75) \times 150000 \times 0.8$

$$\boxed{O/P\ \text{power} = 90000\ W}$$

$\text{Input} = \text{output power} + (P_i + P_c)$

$P_{cu(75\%)} = (\text{Desired load})^2 \times P_{cu}$

$= (0.75)^2 \times 2644.63$

$$\boxed{P_{cu} = 1487.60}$$

$I/P = 90000 + (1487.60 + 1322.31)$

$I/P = 92809.91$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

$$\% \eta = \frac{90000}{92809.91} \times 100$$

$$\boxed{\% \eta = 96.9\%}$$

Auto transformer

Auto transformer consisting of only one winding in a single winding serve the purpose of primary as well as secondary winding.

→ The principle operation of Auto transformer same as the two winding transformer but only one difference i.e primary winding & secondary winding which are not electrically separated.

⇒ The voltage ratio (turns) auto transformer is equal to unity $\boxed{K = 1}$

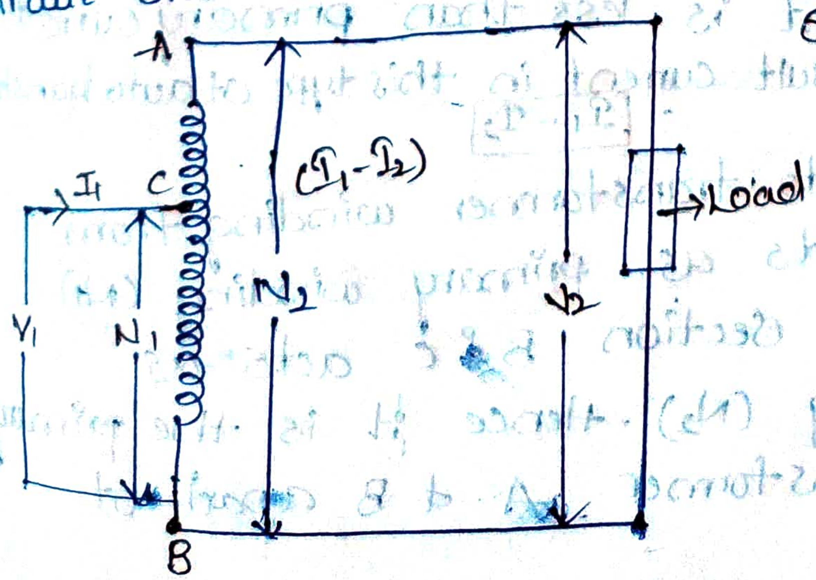
⇒ The classification of auto transformer in two types.

i) step up auto transformer

ii) step down auto transformer.

⇒ step up & step down auto transformer in the circuit shown in fig.

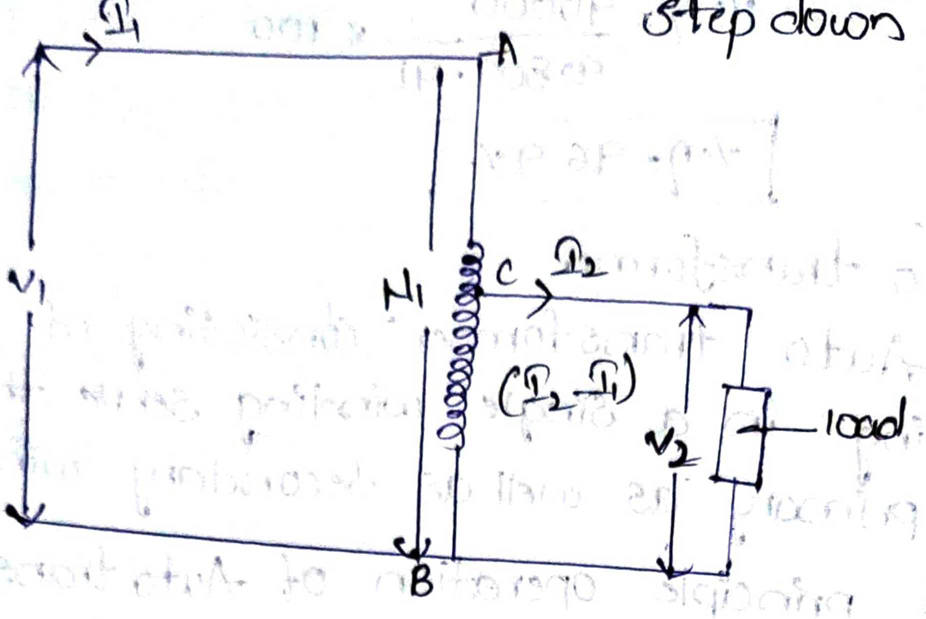
Step up.



www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Step down



⇒ In Stepupot auto transformer winding from Section A & B acts as Secondary winding (N_2) and winding of Section B & C acts as primary winding (N_1). Hence it is Secondary winding A & B a part of primary winding B & C.

⇒ If it is satisfies ~~step~~ condition step of auto transformer are

i) The no. of turns in Secondary is greater no. of turns in Primary $\boxed{N_2 > N_1}$

ii) Secondary Voltage is greater than primary Voltage. $\boxed{V_2 > V_1}$

iii) Secondary current is less than primary current $\boxed{I_2 < I_1}$. The result current in this type of auto transform ∴ $\boxed{I_1 - I_2}$

In Step down auto transformer winding from Section A & B acts as primary winding (N_1) and winding of Section B & C acts as Secondary winding (N_2). Hence it is the primary winding of transformer A & B a part of

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Secondary winding B & C

→ If it is satisfies the conditions step down auto transformer are

i) The no. of turns in primary is greater than no. of turns in secondary $\boxed{N_1 > N_2}$

ii) ~~Secondary~~ primary voltage is greater than secondary terminal voltage $\boxed{V_1 > V_2}$

iii) Primary current is less than secondary current $\boxed{I_1 < I_2}$

Advantages

i) Lowcost

ii) More efficiency

iii) Voltage regulation is more.

iv) Voltage Variation is possible

Disadvantages.

i) The auto transformer mainly due to direct electrically supply from low voltage to high voltage

Applications.

i) It is used to starting of induction motor.

ii) It is used in continuous Varies supply.

iii) It is used in interconnecting transformer supply.

$\frac{132 KVA}{300 KVA}$

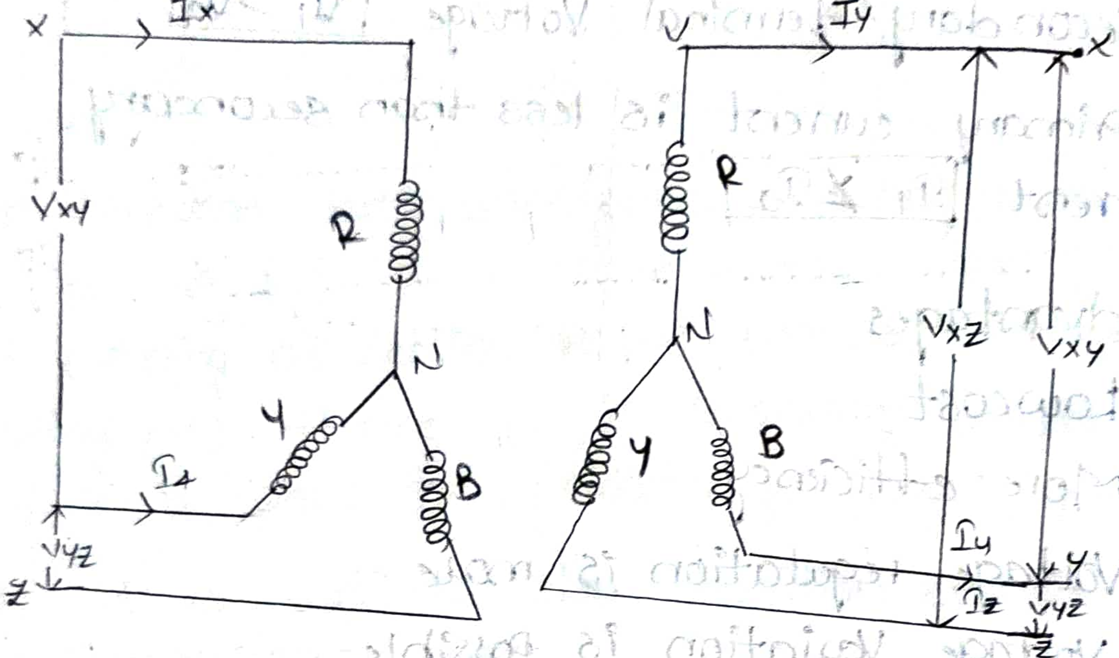
www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Three phase Connections of transformer.

i) Star (Y) to Star (Y) connection
ii) Delta (Δ) to Delta (Δ) connection
iii) star (Y) to Delta (Δ) Connection
iv) Delta (Δ) to star (Y) connection.

i) Star to star connection.



Primary line Voltage $= V_L$

Primary phase Voltage $= \frac{V_L}{\sqrt{3}}$

Primary phase current $= I_L$

Secondary phase voltage $= \frac{KV_L}{\sqrt{3}}$

Secondary phase Current $= \frac{I_L}{K}$

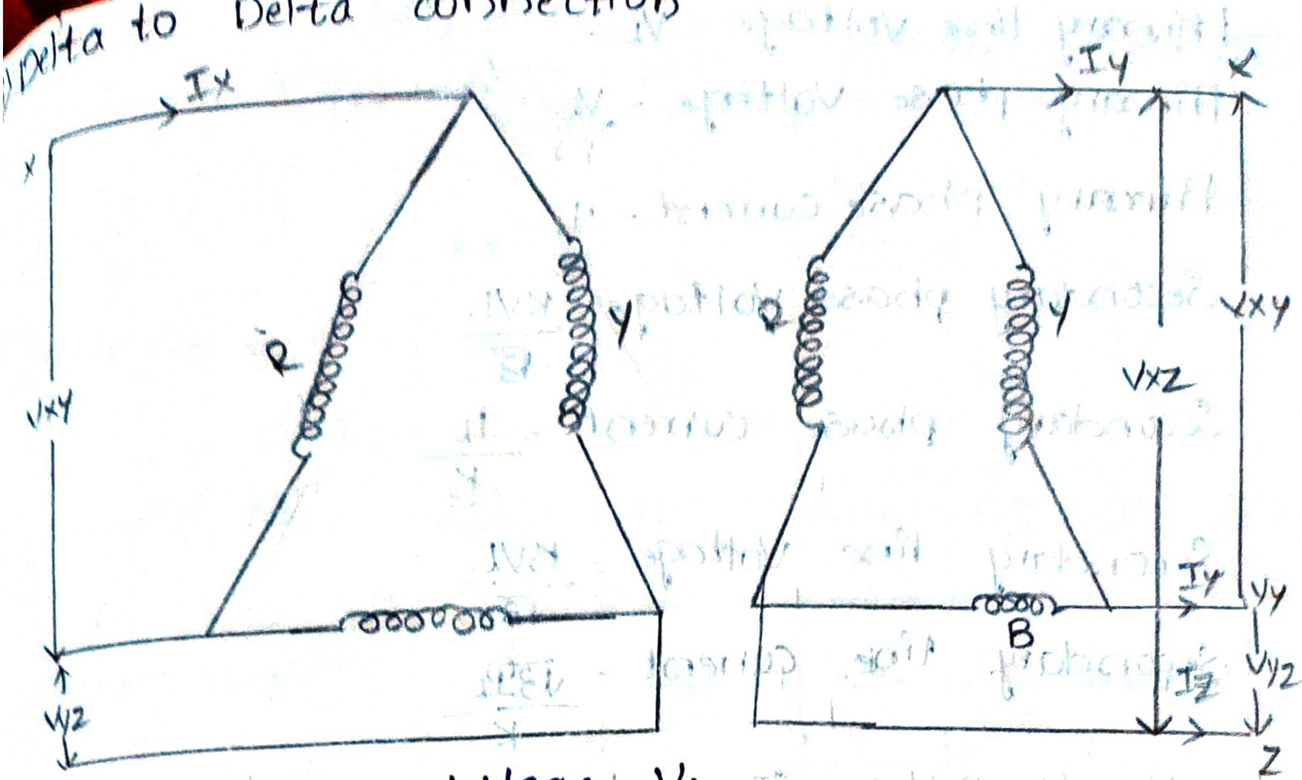
Secondary ~~Phase~~ line current $= KV_L$

Secondary line current $= \frac{I_L}{K}$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Delta to Delta connection



Primary line Voltage $= V_L$

Primary phase Voltage $= V_L$

Primary phase current $= \frac{I_L}{\sqrt{3}}$

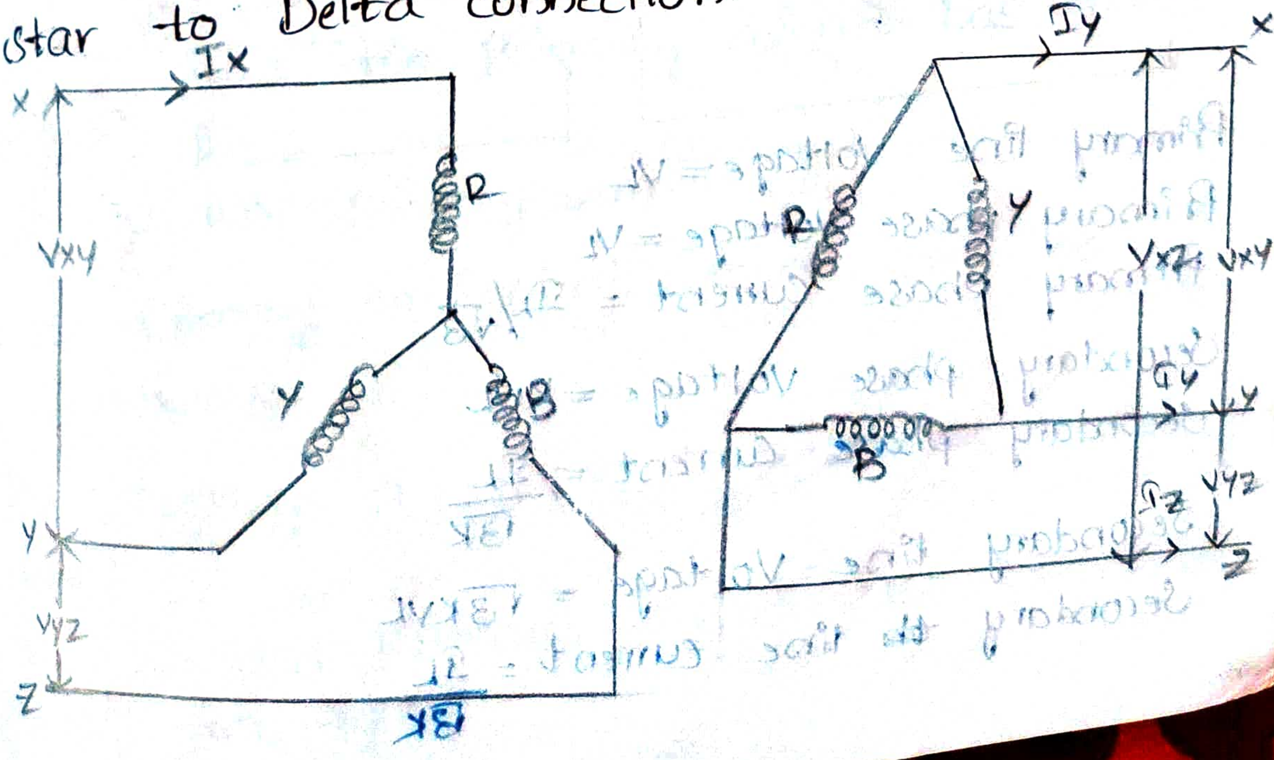
Secondary phase Voltage $= KV_L$

Secondary phase current $= \frac{I_L}{\sqrt{3}K}$

Secondary line Voltage $= KV_L$

Secondary line current $= \frac{I_L}{K}$

Star to Delta connection.



www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Primary line voltage $= V_L$

Primary phase voltage $= \frac{V_L}{\sqrt{3}}$

Primary phase current $= I_L$

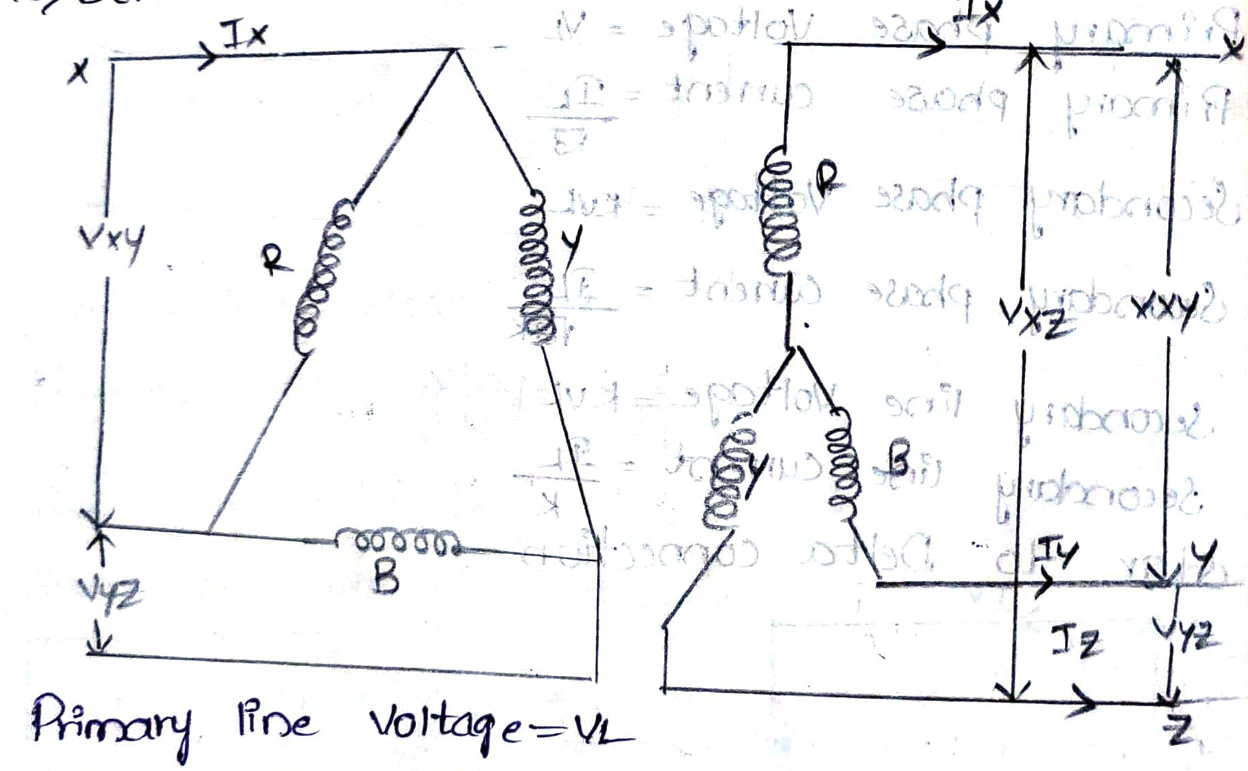
Secondary phase voltage $= \frac{KV_L}{\sqrt{3}}$

Secondary phase current $= \frac{I_L}{K}$

Secondary line voltage $= \frac{KV_L}{\sqrt{3}}$

Secondary line current $= \frac{\sqrt{3}I_L}{K}$

iv) Delta to Delta connection.



Primary line voltage $= V_L$

Primary phase voltage $= V_L$

Primary phase current $= I_L/\sqrt{3}$

Secondary phase voltage $= KV_L$

Secondary phase current $= \frac{I_L}{\sqrt{3}K}$

Secondary line voltage $= \sqrt{3}KV_L$

Secondary ~~th~~ line current $= \frac{I_L}{\sqrt{3}K}$

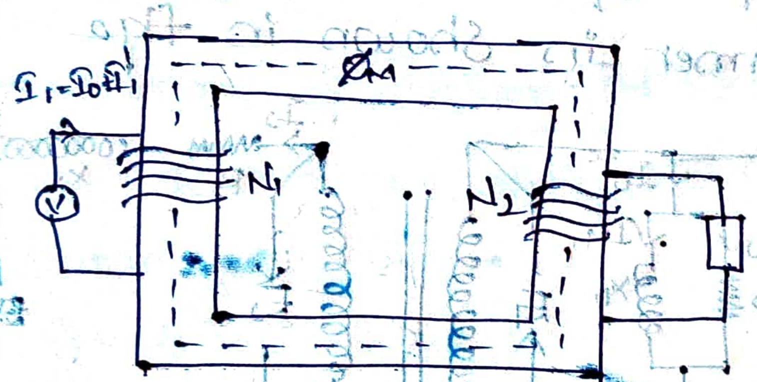
www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

Types of connection	Primary Side			Secondary Side			
	line voltage	Phase voltage	Phase current	Phase voltage	phase current	line voltage	line current
Star to Star (Y) (Y)	V_L	$\frac{V_L}{\sqrt{3}}$	I_L	$\frac{KV_L}{\sqrt{3}}$	$\frac{I_L}{K}$	KV_L	$\frac{I_L}{K}$
Delta to Delta (Δ) (Δ)	V_L	V_L	$\frac{I_L}{\sqrt{3}}$	KV_L	$\frac{I_L}{\sqrt{3}K}$	KV_L	$\frac{I_L}{K}$
Star to Delta (Y) (Δ)	V_L	$\frac{V_L}{\sqrt{3}}$	I_L	$\frac{KV_L}{\sqrt{3}}$	$\frac{I_L}{K}$	$\frac{KV_L}{\sqrt{3}}$	$\frac{\sqrt{3}I_L}{K}$
Delta to Star (Δ) (Y)	V_L	V_L	$\frac{I_L}{\sqrt{3}}$	KV_L	$\frac{I_L}{\sqrt{3}K}$	$\sqrt{3}KV_L$	$\frac{I_L}{\sqrt{3}K}$

Equivalent Circuit of Single phase transformer.

The signal phase transformer the circuit shown in fig.



Here the primary current has two Components.

i) No-load primary Current (I_0)

ii) The Primary equivalent current refer to Secondary (I_1')

→ The purpose of I_1' to balance the Secondary Current

→ The no load primary Current also sub-divided into two types.

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

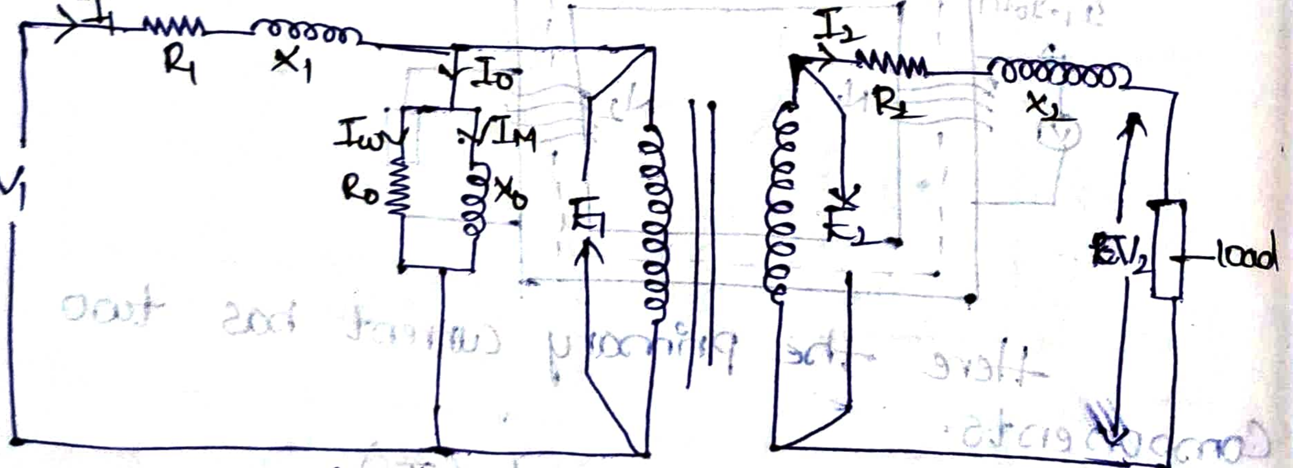
i) Working component of no load current (I_w) (or) Active component of no load current

ii) Magnesiation component of no load current (I_M) (or) Reactive component of no load current.

→ The working component of no load current which produces the Iron/core losses. Hence it is represented as equivalent resistance (R_0)

→ The Magnesiation component of no load current which produce the magnetic flux & generate the induced emf. Hence it is represented as equivalent reactance (X_0)

→ To combination of Active & Reactive component of equivalent circuit of signal phase transformer in shown in fig:



Equivalent Circuit of 1-ø transformer

) The equivalent circuit of single phase transformer refer to primary side

Let consider secondary values transfered to primary side in equivalent circuit of transformer

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

The equivalent circuit of transformer completely depends upon voltage ratio of transformer

$$\boxed{K = \frac{E_2}{E_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2} = \frac{V_2}{V_1}}$$

E_2' = The primary equivalent of secondary induced emf $K = \frac{E_2}{E_1}$

$$E_2' \Rightarrow E_1 = \frac{E_2}{K}$$

V_2' = The primary equivalent of secondary terminal voltage $V_2' \Rightarrow V_1 = \frac{V_2}{K}$

I_2' = The primary equivalent of secondary current

$$I_2' \Rightarrow I_1 = I_2 K$$

R_2' = The primary equivalent of secondary resistance

The copper losses of each winding of transformer

$$I_1^2 R_1 = I_2^2 R_2 \quad [R_2' = R_1]$$

$$I_1^2 R_2' = I_2^2 R_2$$

$$R_2' = \frac{I_2^2}{I_1^2} \times R_2$$

$$\boxed{R_2' = \frac{R_2}{K^2}}$$

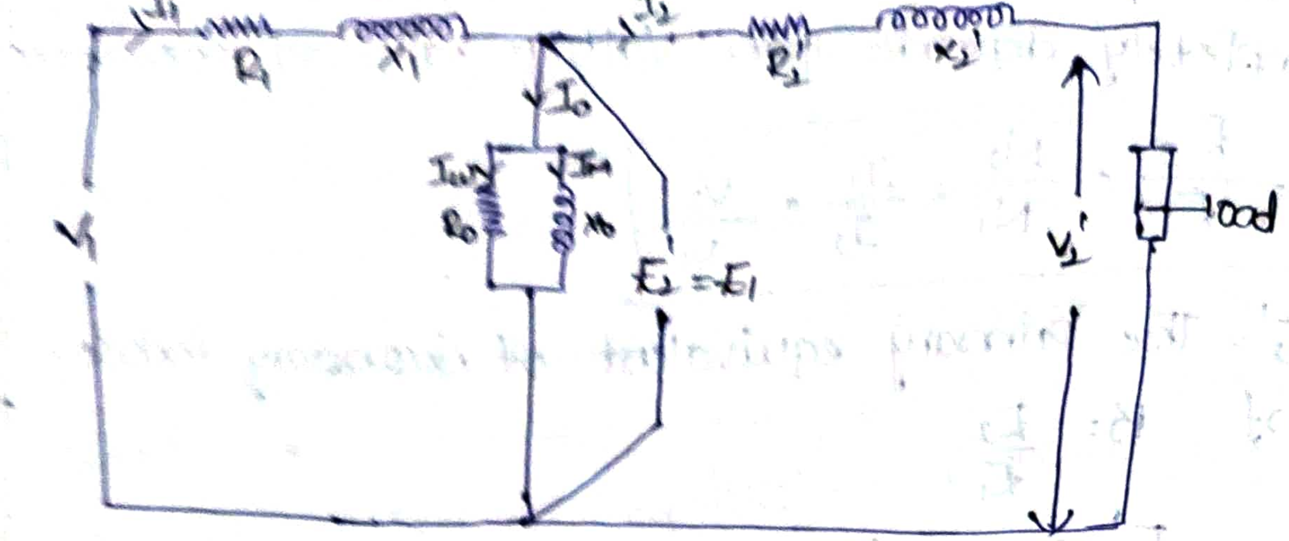
X_2' = The primary equivalent of second reactance

$$X_2' = \frac{X_2}{K^2}$$

The equivalent circuit of single phase transformer refered to primary side in the circuit shown in fig 3

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in



The equivalent resistance of transformer Primary side is given as $R_{01} = R_1 + R_2'$

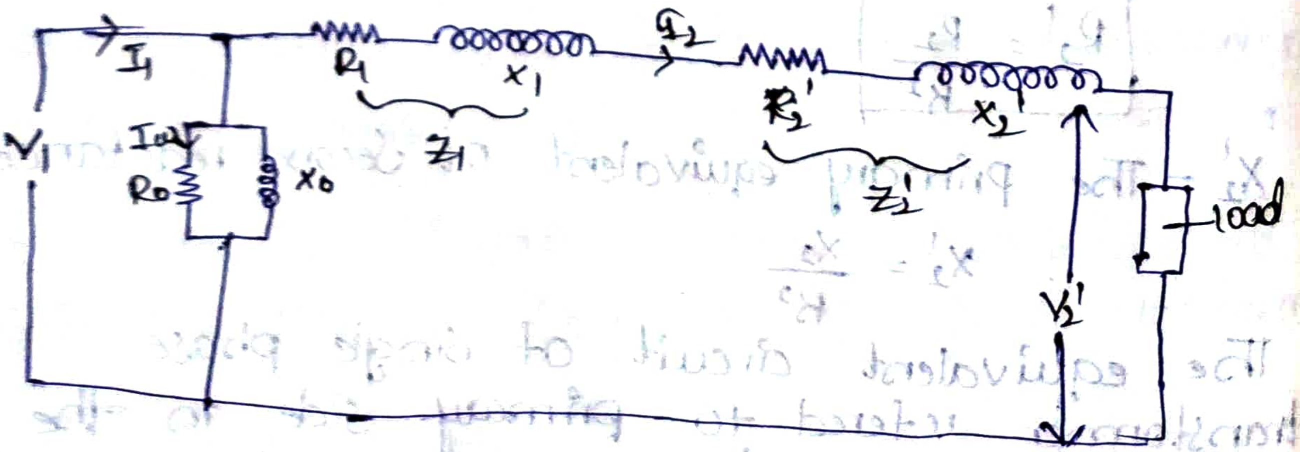
$$\boxed{R_{01} = R_1 + \frac{R_2}{K^2}}$$

The equivalent reactance of transformer in Primary side is given as $X_{01} = X_1 + X_2'$

$$\boxed{X_{01} = X_1 + \frac{X_2}{K^2}}$$

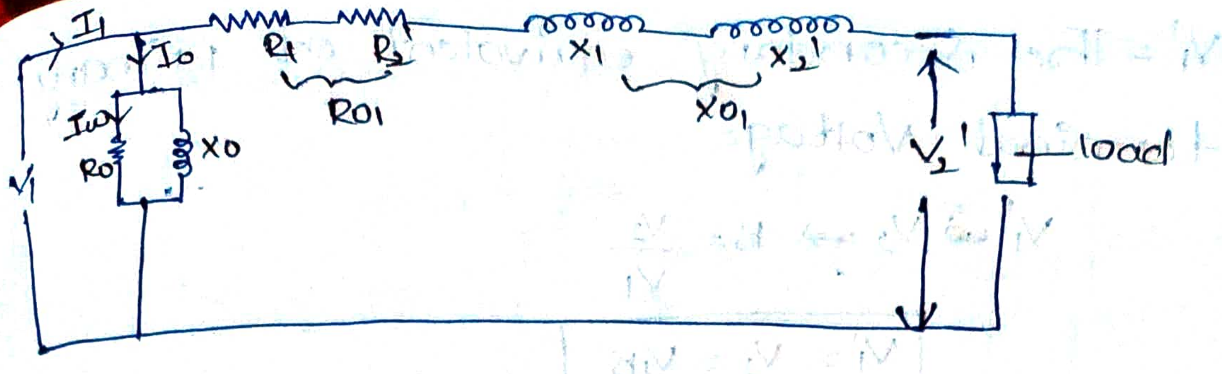
The combination of equivalent resistance and equivalent reactance is known as equivalent impedance. It is denoted by "Z"

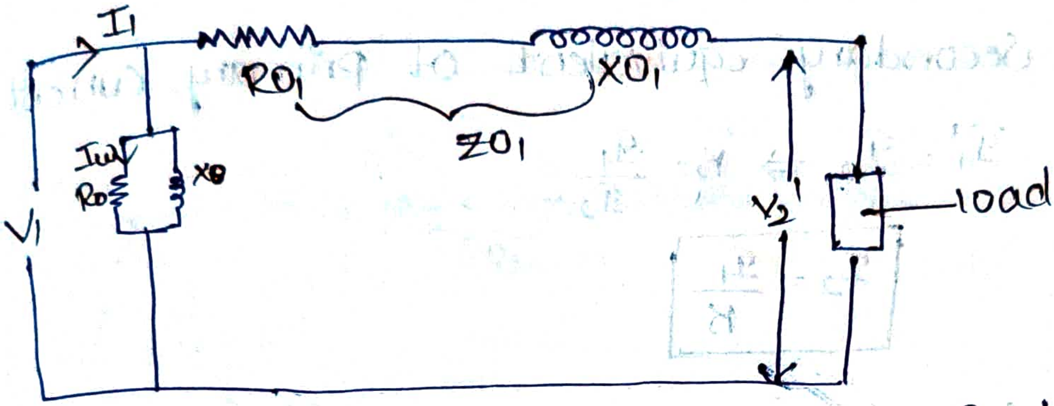
$$Z = \underbrace{R}_{\text{Resistance terminal}} + j\underbrace{X_L}_{\text{Reactance terminal}}$$



www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in





The total impedance of equivalent circuit of single phase transformer in primary sides given as

$$\boxed{Z_{01} = R_{01} + jX_{01}}$$

equivalent circuit of single phase transformer refer to the secondary side.

The voltage ratio of single phase transformer is given as

$$\boxed{K = \frac{E_2}{E_1} = \frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}}$$

Let consider transfer to primary values to secondary

E_1' = secondary equivalent of primary induced emf $E_1' = E_2 \Rightarrow K = \dfrac{E_2}{E_1}$

$$\boxed{E_2 = E_1 K}$$

$$\boxed{E_1' = E_2 = E_1 K}$$

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

V_1' = The Secondary equivalent of primary terminal Voltage

$$V_1' = V_2 \Rightarrow K = \frac{V_2}{V_1}$$

$$\boxed{V_1' = V_2 = V_1 K}$$

I_1' = The Secondary equivalent of primary current

$$I_1' = I_2 \Rightarrow K = \frac{I_1}{I_2}$$

$$\boxed{I_2 = \frac{I_1}{K}}$$

R_1' = The Secondary equivalent of primary resistance.

The copper losses of single phase transformer in respective winding is given as $I_1^2 R_1 = I_2^2 R_2$

$$\therefore I_1^2 R_1 = I_2^2 R_2 \qquad \therefore R_1' = R_2$$

$$I_1^2 R_1 = I_2^2 R_1'$$

$$R_1' = \frac{I_1^2}{I_2^2} \times R_1$$

$$\boxed{R_1' = R_1 K^2}$$

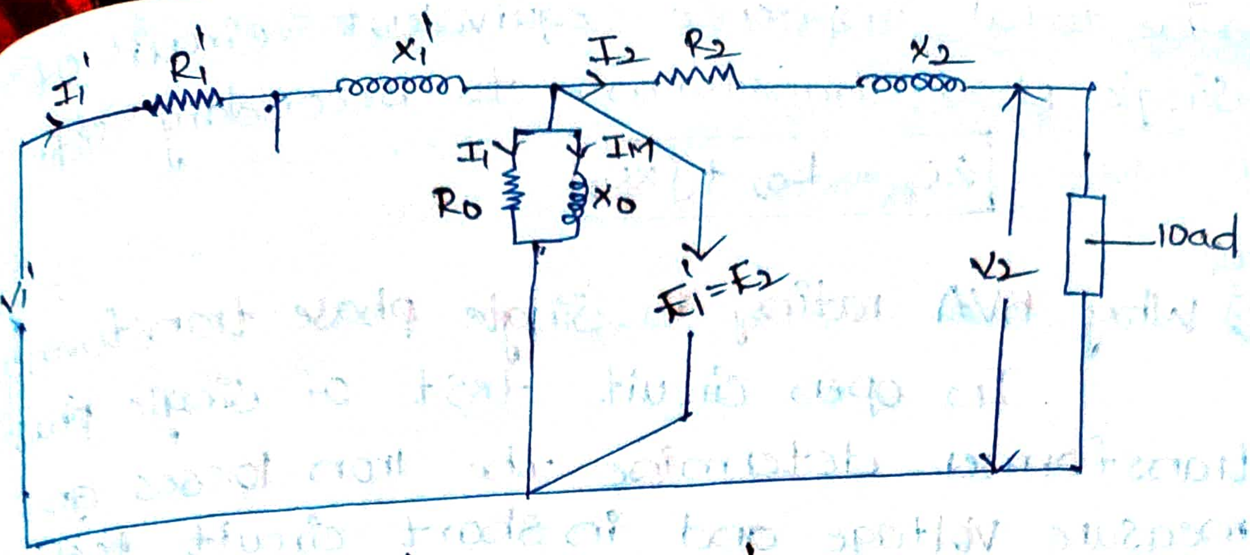
X_1' = The Secondary equivalent of primary reactance is given as

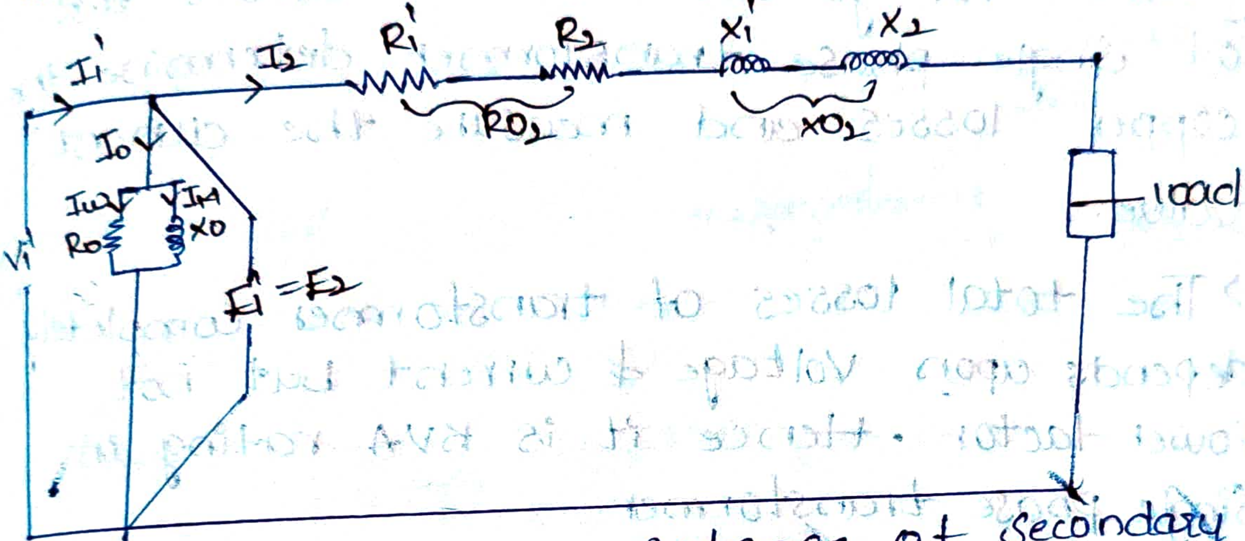
$$\boxed{X_1' = X_1 K^2}$$

The equivalent circuit single phase transformer refer to Secondary side in the circuit shown in fig.

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in



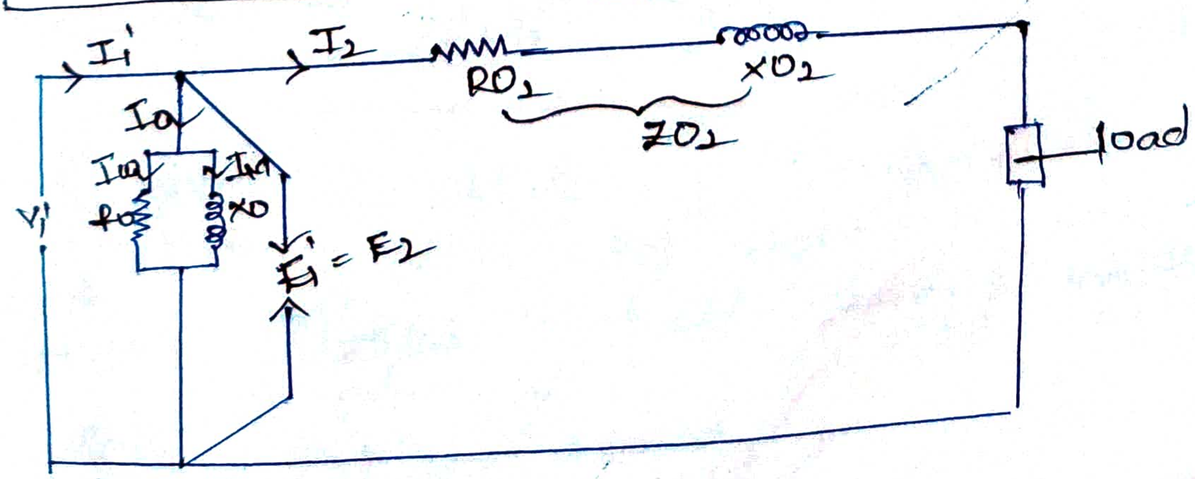


The equivalent resistance of secondary side $RO_2 = R_1' + R_2$

$$\boxed{RO_2 = R_1 K^2 + R_2}$$

The total equivalent reactance of secondary side is given as $XO_2 = X_1' + X_2$

$$\boxed{XO_2 = X_1 K^2 + X_2}$$



www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com

www.android.universityupdates.in | www.universityupdates.in | www.ios.universityupdates.in

→ The total impdence equivalent circuit of Single phase transformer to secondary side

$$\boxed{Z_{O_2} = R_{O_2} + jX_{O_2}}$$

Imp

Q) Why KVA rating in single phase transformer?

In open circuit test of single phase transformer determine the Iron losses and measure Voltage and in short circuit test of single phase transformer determine the copper losses and measure the current value.

→ The total losses of transformer completely depends upon Voltage & current but not Power factor. Hence it is KVA rating in single phase transformer.

www.android.previousquestionpapers.com | www.previousquestionpapers.com | www.ios.previousquestionpapers.com