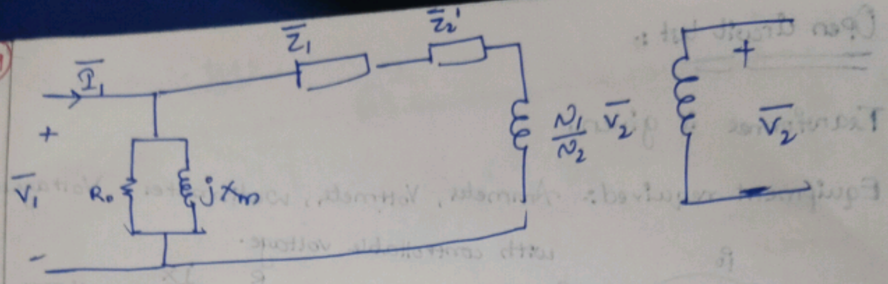
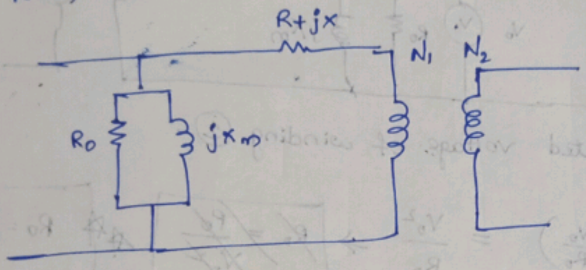
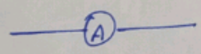


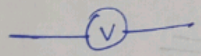
Now, here



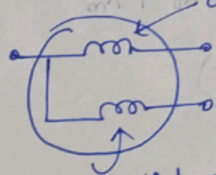
<u>Approximate equivalent circuit:</u>

Determination of values of parameters R_0, X_m, R, X

Ammeter 

Voltmeter 

wattmeter
↓
measures
active power



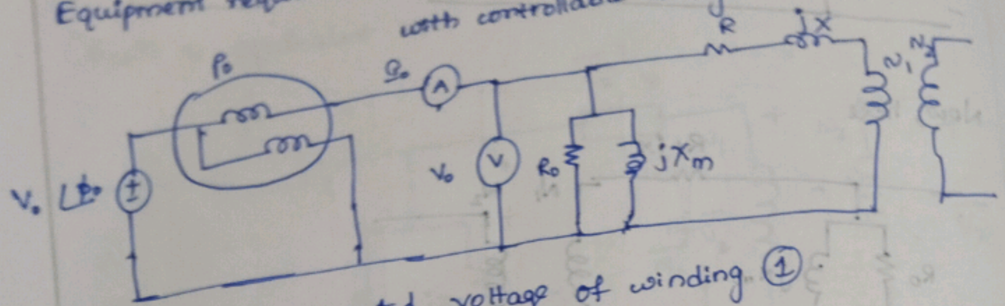
Voltage across terminals of ammeter = 0
Current through voltmeter = 0
Voltage across current coil of wattmeter = 0
Current through potential coil of wattmeter = 0

Now,

* Open circuit test :-

Transformer is given.

Equipment required: Ammeter, Voltmeter, Watt meter, Voltage source with controllable voltage.



V_0 is equal to rated voltage of winding (1).

and $P_0 = V_0\left(\frac{V_0}{R_0}\right) = \frac{V_0^2}{R_0} \Rightarrow \boxed{\cancel{R_0 = \frac{P_0}{V_0^2}}}$ ** $\boxed{R_0 = \frac{V_0^2}{P_0}}$

$$I_0 = \frac{V_0\sqrt{R_0^2+X_m^2}}{R_0 X_m}$$

and $\Rightarrow$ $$\frac{V_0}{X_m} = \frac{R_0 I_0}{\sqrt{R_0^2+X_m^2}}$$

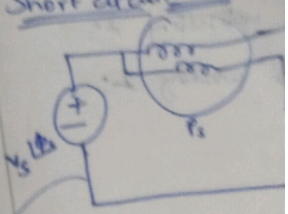
$$I_0^2 = \frac{V_0^2\left(R_0^2+X_m^2\right)}{R_0^2 X_m^2}$$

$$I_0^2 = V_0^2\left(\frac{1}{X_m^2}+\frac{1}{R_0^2}\right)$$

$$\frac{V_0}{X_m} = \sqrt{I_0^2-\left(\frac{V_0}{R_0}\right)^2}$$

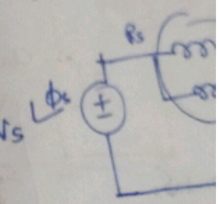
$$\Rightarrow \boxed{X_m = \frac{V_0}{\sqrt{I_0^2-\left(\frac{V_0}{R_0}\right)^2}}}$$ **

* Short circuit test:



I_s is equal to rat

I_s approxi

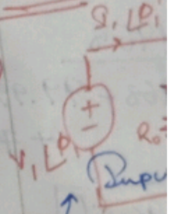


$P_s = I_s^2 R =$

$\frac{V_s}{I_s} = \sqrt{}$

* Load:- Equ

Q)



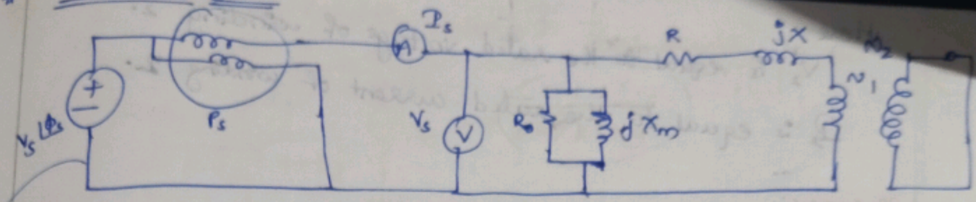
Type

for this

this, cal

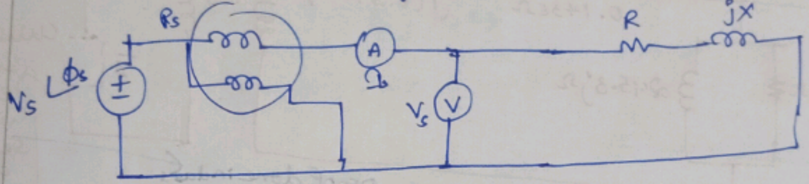
Fo

Short circuit test:



I_s is equal to rated current of winding ①.

→ I_s approximated by

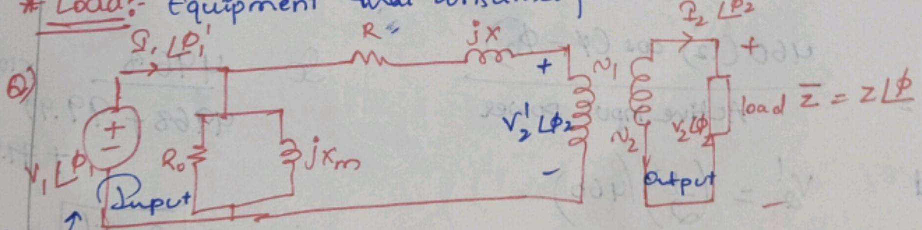


$P_s = I_s^2 R \Rightarrow \boxed{R = \frac{P_s}{I_s^2}}$

$\frac{V_s}{I_s} = \sqrt{R^2 + X^2} \Rightarrow \boxed{X = \sqrt{\left(\frac{V_s}{I_s}\right)^2 - R^2}}$

*** Load:** - Equipment that consumes power.

Q)



Type:

for this we can also measure the performance of transformer, this is called voltage regulation.

Here $V_2' = \frac{N_1}{N_2} V_2$

For a given power factor of the load, voltage regulation $= \frac{V_1 - V_2'}{V_2'} \times 100\%$.

102

Here

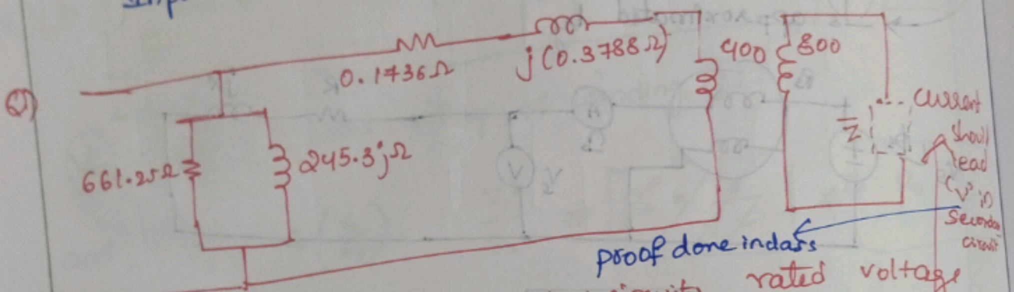
V_2 is equal to the rated voltage of winding 2.

I_2 is equal to the rated current of winding 2.

* **Efficiency**:-

$$\frac{\text{Output active power}}{\text{Input active power}} \times 100\%$$

Q)



For transformer with this equivalent circuit rated voltage of winding '2' is 460V and rated current of winding '2' is 12A. Find pf of the load at which voltage regulat = 0 with rated voltage at terminals of winding '2' and rated current through the load. At this pf, what is the efficiency

$$pf = \frac{460(12)\cos(\phi - \phi_2)}{\text{Active input power}}$$

So $\frac{4968}{4968 + 99.99} \times 100\%$ $+ 79.\%$

$= \boxed{96.5\%}$

and $V_2' = \left(\frac{1}{2}\right)(460)$

$V_2' = 230\ V$

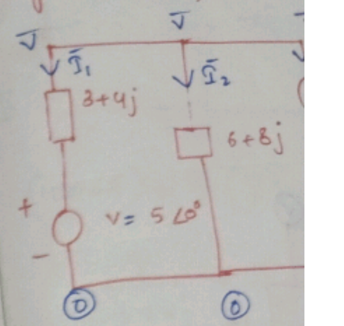
So as regulation = 0 $\Rightarrow V_1 = 230\ V$

and hence Active input power $= V_1 I_1 \cos(\phi_1 - \phi_1')$

103

Problems:-

Q) Using Kirchoff law, Calculat



Sol.

$(\bar{V} - 5\angle 0) = \bar{I}_1$

$\bar{V} = \bar{I}_2(1$

$\bar{V} + 4.47\angle 63.4°$

and $\bar{I}_1 + \bar{I}_2 +$

$\frac{(\bar{V} - 5)}{5}$

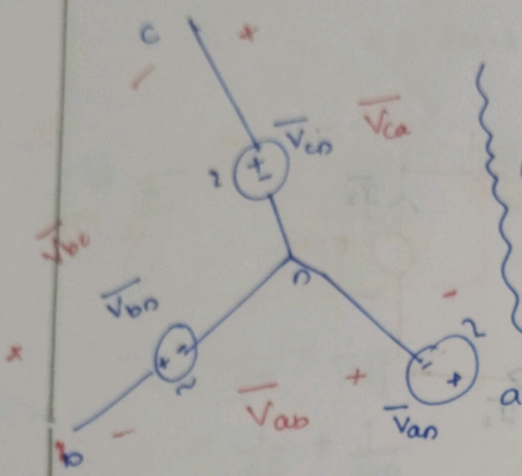
$\left(\frac{\bar{V}}{5}\right) - 1($

$\frac{\bar{V}}{5} -$

$(4.4$

108 17-01-23

* Three phase AC circuits:



Y-connection
(or)
Wye-connection
(or)
Star-connection

a, b, c are line terminals
'n' is neutral.

⇒ Voltage source with voltage $\overline{V}_{an}$ is said to be in phase 'a' or belong to phase 'a'. Similarly for $\overline{V}_{bn}$ for 'b' and $\overline{V}_{cn}$ for 'c'.

⇒ $\overline{V}_{an}, \overline{V}_{bn}, \overline{V}_{cn}$ are phase voltages.

⇒ $\overline{V}_{ab}, \overline{V}_{bc}, \overline{V}_{ca}$ are called line-to-line voltages / Line voltages

let,

$$\overline{V}_{an} = V_p \angle 0, \quad V_{bn} = V_p \angle -120^\circ, \quad \overline{V}_{cn} = V_p \angle 120^\circ$$

P : phase,

If three voltages are having same RMS value and if the modulus of phase difference b/w any two of these three voltages is 120°, then the three voltages are said to be balanced.

Now

$$\overline{V}_{ab} = \overline{V}_{an} - \overline{V}_{bn} = V_p \angle 0^\circ - V_p \angle -120^\circ = \sqrt{3}\, V_p \angle 30^\circ$$

109

$\overline{V}_{bc} = \overline{V}_{bn}$

$= V_p$

$\overline{V}_{ca} =$

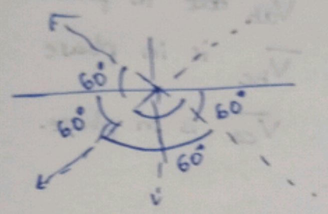
So

let

So

$\overline{V_{bc}} = \overline{V_{bn}} - \overline{V_{cn}}$

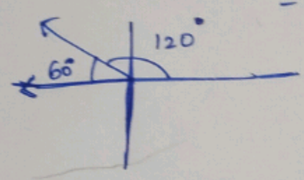
$= V_p \angle -120^\circ - V_p \angle 120^\circ \quad = \sqrt{3}\, V_p \angle -90^\circ$



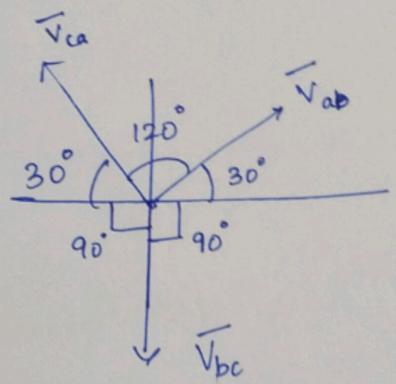
$\overline{V_{ca}} = \overline{V_{cn}} - \overline{V_{an}}$

$= V_p \angle 120^\circ - V_p \angle 0^\circ$

$= \sqrt{3}\, V_p \angle +150^\circ$



So



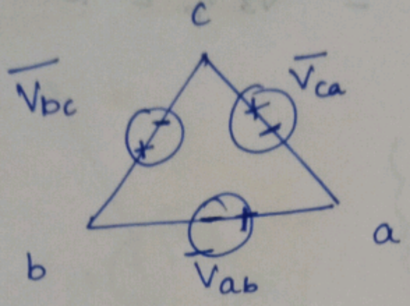
Let $V_L = \sqrt{3}\, V_p$

So $\overline{V_{ab}} = V_L \angle 30^\circ$

$\overline{V_{bc}} = V_L \angle -90^\circ$

$\overline{V_{ca}} = V_L \angle 150^\circ$

* Delta Connection: (Δ-connection)



$\overline{V_{ab}}$ ~~are~~ is in phase

$\overline{V_{bc}}$ is in phase

$\overline{V_{ca}}$ is in phase.

$\Rightarrow$ a, b, c are the line terminals

$\Rightarrow$ $\overline{V_{ab}}$, $\overline{V_{bc}}$, $\overline{V_{ca}}$ are phase voltages. We can also call them as line voltages.