BRAC UNIVERSITY

BSRM School of Engineering

Department of Electrical and Electronic Engineering

Lab Report

Fall 2025

Course Code: **EEE221L**

Course Title: Energy Conversion I Laboratory

Lab Section: 03

Experiment No.: 02

Name of the experiment: Determination of the equivalent circuit parameter and efficiency calculation of a Single phase Transformer.

Date of Submission: 29/10/25

Group No: 03

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Submitted by

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Objectives: To perform open circuit test and short circuit test.

Apparatus: Wattmeter, AC-Ammeter, AC-Voltmeter, 3-phase variable AC supply.

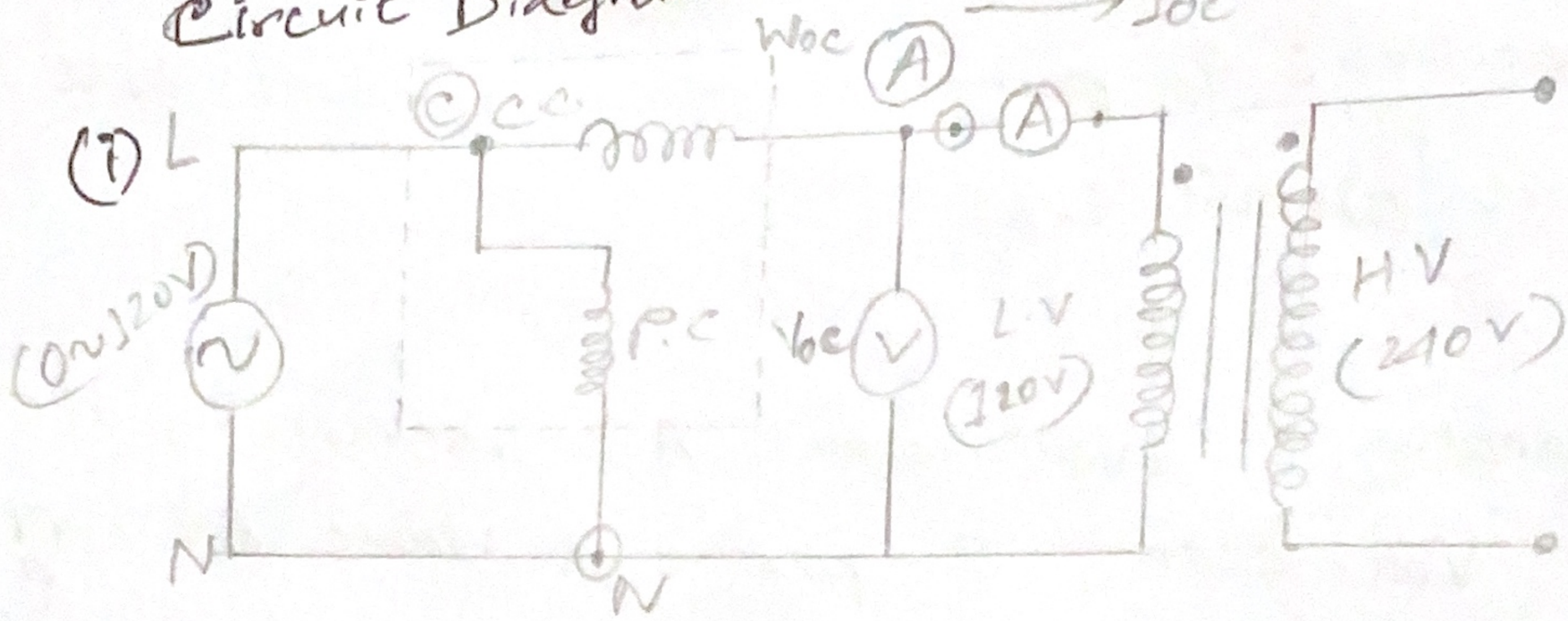
Theoretical Background:

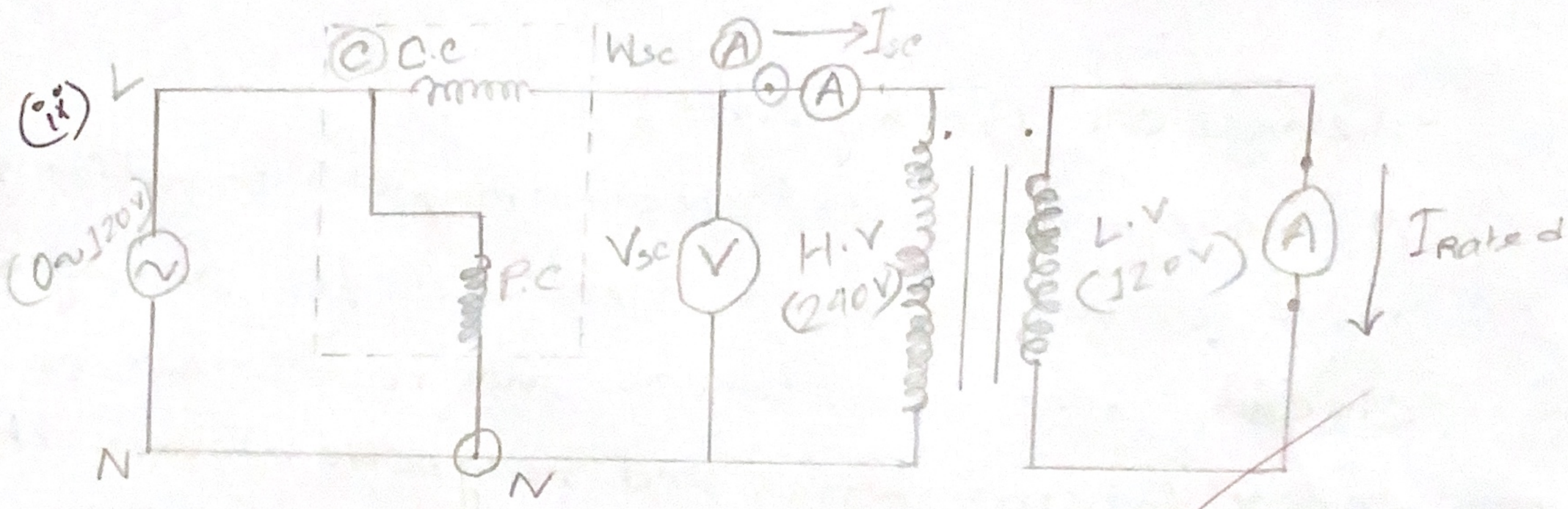
A transformer uses electromagnetic induction to move power between circuits. It's analogous circuit uses resistances and reactances to depict internal losses and magnetic effects. Whereas the short circuit test determines leaking reactance and winding resistance, the open circuit test determines core losses and magnetizing characteristics. Without operating at full load, these tests aid in determining efficiency and voltage regulation.

Eq. circuit diagram:

Circuit Diagram :

(i) For open circuit te





(ii) For short circuit test

Procedure :

For open circuit test :

i) H.V side open

ii) Apply V- rated at L.V side

iii) Measurements refer to L.V side

For short circuit test :

i) Shortened the L.V side

ii) Apply voltage so that I rated flows.

iii) Measurements referred to L.V side.

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7. Data Table:

KVA rating	Voltage rating
Data for open circuit test (referred to LT side):	**Data for short circuit test (referred to HT side):**
Input power (W_{oc}), watts = ~~47~~ 7	Input power (W_{sc}), watts = 11W
Input current (I_{oc}), amps = 0.101 ~~mA~~	Input current (I_{sc}), amps = 0.608
Input voltage (V_{oc}), volts = 120	Input voltage (V_{sc}), volts = 22.5

Faculty Signature and Date

8. Calculation:

Open Circuit Test:

$W = V_0 I_0 \cos\varphi_0$

$\cos\varphi_0 = \frac{W}{V_0 I_0} = \frac{7}{120 \times 0.101} = 0.583 \quad \therefore \varphi_0 = 54.31$

Magnetizing current, $I_\mu = I_0 \sin\varphi_0$ 0.082 A

Copper Loss current, $I_w = I_0 \cos\varphi_0$ 0.0589 A

No load resistance, $R_0 = \frac{V_0}{I_w}$ 2037.35 Ω

No load reactance, $X_0 = \frac{V_0}{I_\mu}$ 1463.41

Short Circuit Test:

Equivalent resistance, $R_{01} = \frac{W_{sc}}{(I_{sc})^2}$ $\frac{11}{0.608^2} = 29.76\,\Omega$

$Z_{sc} = \frac{V_{sc}}{I_{sc}}$ 37.006

Equivalent reactance, $X_{01} = \sqrt{(Z_{sc})^2 - (R_{01})^2}$ 21.995

9. Question:

(1) Determine the equivalent circuit parameters of the transformer from the test data.
(2) What are the approximations of the short and the open circuit tests?
(3) Why open circuit test is performed in the high tension side whereas short circuit test is performed in the low tension side?

Calculations :

O/C Test :

$$\begin{cases} Y_E = \dfrac{I_{oc}}{V_{oc}} \angle \cos^{-1} PF \\ PF = \cos\theta = \dfrac{P_{oc}}{V_{oc} I_{oc}} \\ Y_E = G_c - jB_M \\ R_c = \dfrac{1}{G_c} \; ; \; X_M = \dfrac{1}{B_M} \end{cases}$$

S/C Test :

$$\begin{cases} Z_{SE} = \dfrac{V_{sc}}{I_{sc}} \angle \cos^{-1} PF \\ PF = \cos\theta = \dfrac{P_{sc}}{V_{sc} I_{sc}} \\ Z_{SE} = R_{eq} + jX_{eq} \end{cases}$$

Results :

~~Open~~ copper loss = 0.103 W

Reactance loss = 0.147 W

Equivalent resistance = 29.76 Ω

Equivalent reactance = 21.995 Ω

Questions:

(1)

Open - circuit : $V_{oc} = 120V$, $I_{oc} = 0.101$, $W_{oc} = 7W$

Short - circuit : $V_{sc} = 22.5V$, $I_{sc} = 0.608$, $W_{sc} = 11W$

(2)

Approximation used: ~~For S.C.~~

(Open circuit test):-

i) Series impedance drop is neglected since no-load current is very small.

~~vii)~~ Copper losses are neglected; measured $P_{oc} \approx$ core loss only. These are same

(3)

~~closed~~ ~~cir~~ (Short circuit test):-

i) Applied voltage is very small, so flux and core losses are negligible.

ii) Exciting branch / magnetizing current is ignored; measured $P_{sc} \approx$ copper loss only.

(3)

Open circuit test is done on high tension (HT) side as it needs rated voltage but draws very small current. In that case, applying rated voltage is safe and convinient. The power required is very low and instruments are not heavily loaded.

Short circuit test requires rated current but small amount of voltage. Doing the test

on the low tension / low voltage side keeps the applied voltage and low input power ensuring safety.

If it was done the other way i.e. on the H.T or high tension side, high ~~rated~~ current at high voltage would be dangerous.