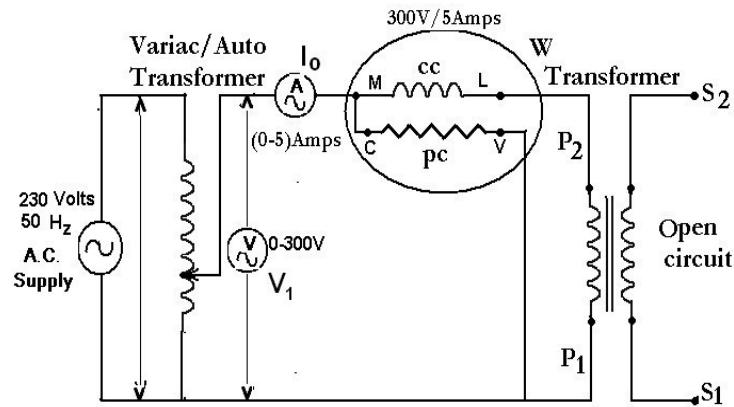
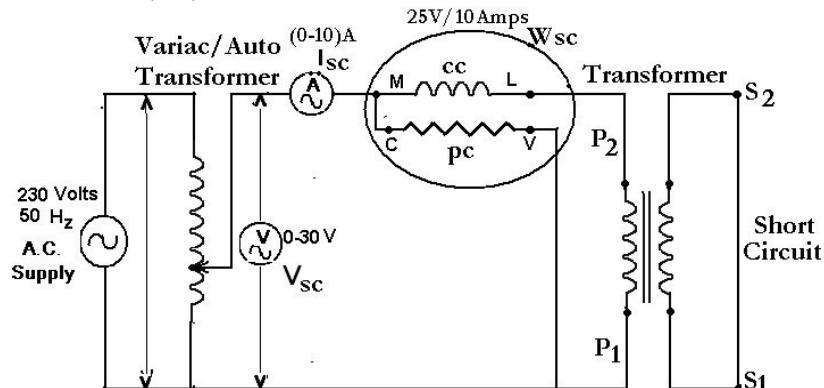
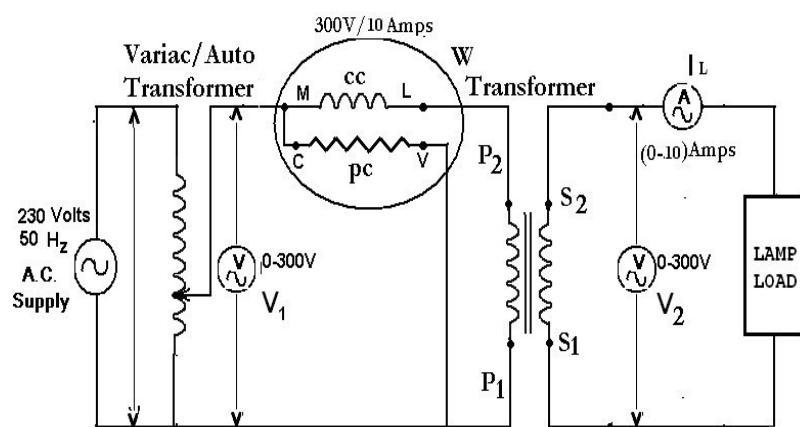


Verification of transformer performance by OC & SC Tests and by direct loading

CIRCUIT DIAGRAM:**Part 1: Open Circuit (OC) Test****Part 2: Short Circuit (SC) Test****Part 3: Load Test**

EXPERIMENT No: 8**DATE:19/05/ 2022**

Verification of transformer performance by OC & SC Tests and by direct loading

AIM: To perform Open circuit, short circuit, and load test on single phase 230V, 10A transformer for obtaining equivalent circuit, regulation and efficiency of transformer.

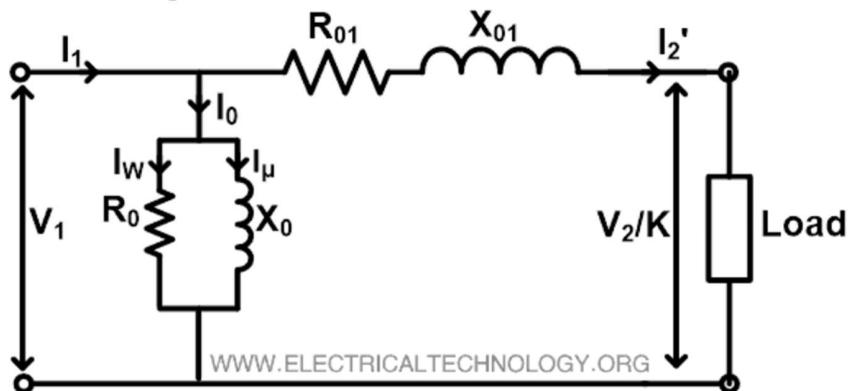
APPARATUS AND COMPONENTS REQUIRED:

1-Φ Auto transformer, Transformer (Rating), Ammeters (Range), Voltmeters (Range), Wattmeters (Rating), Lamp load, Connecting wires

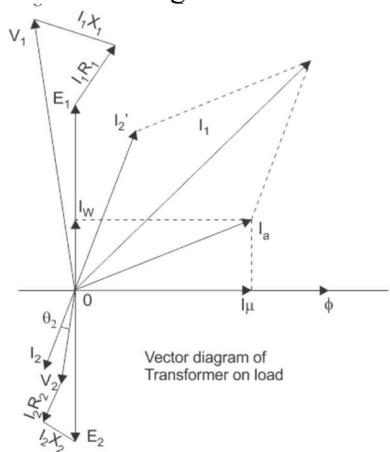
THEORY: Write theory related with following questions:

1) Obtain equivalent circuit of transformer and draw the vector diagram.

Ans) The equivalent circuit diagram of a transformer is a simplified circuit in which the impedance, resistance and leakage reactance of the transformer can be more easily calculated. The equivalent circuit is



The vector diagram is :



b) What is OC and SC test of transformer? How will it help to find the equivalent circuit of transformer?

Ans) Open and short circuit tests are performed on a transformer to determine the:

Equivalent circuit of transformer

Voltage regulation of transformer

Efficiency of transformer

The power required for open circuit tests and short circuit tests on a transformer is equal to the power loss occurring in the transformer.

The open circuit test on transformer is used to determine core losses in transformer and parameters of the shunt branch of the equivalent circuit of the transformer.

The short-circuit test of a transformer is used to determine copper losses in the transformer at full load. It is also used to obtain the parameters to approximate the equivalent circuit of a transformer.

c) Define regulation and efficiency of transformer.

Ans) Regulation: It is percentage of voltage difference between no load and full load voltage of a transformer with respect to its full load voltage.

Efficiency: It is the ratio of output power by input power multiplied by 100 where input power is equal to output power plus losses.

d) How the parameters obtained from OC and SC test can help for calculation of efficiency and regulation of transformer?

Ans) The parameters found from OC and SC test help in calculation of efficiency and regulation of transformer as it provides with the losses of the transformer

PROCEDURE:

OC Test

- 1) Make connections as per the circuit diagram.
- 2) Adjust the autotransformer to the rated voltage of transformer (230V).
- 3) Record I_0 , V_1 and W_i .
- 4) Set the autotransformer to zero position. Turn the power off and remove the connections for the circuit.

SC Test

- 5) Make connections as per the circuit diagram.
- 6) Make sure that the 1-Φ variable autotransformer (VARIAC) is kept in ZERO Position initially.
- 7) Turn the power on. Slowly vary the 1-Φ autotransformer (VARIAC) to set the current to rated current of transformer (10A).
- 8) Record V_1 , I_{sc} and W_{Cu} .
- 9) Set the autotransformer to zero position. Turn the power off. Remove the connections for the circuit.

OBSERVATION TABLE:**For Part 1: OC Test**

V₁ (Volt)	I₀ (Amp)	W_i (Watt)
230	13.2	255

For Part 2: SC Test

V₁ (Volt)	I_{sc} (Amp)	W_{Cu} (Watt)
12.46	10	20

For Part 3: Load Test $V_1 = V_2 = 230V$

Sr. No	V₂ (Volt)	I_L (Amp)	W₁ (Watt)
1	234.1	0	39
2	233.3	0.78	220.8
3	232.8	1.56	405
4	231.8	2.31	580
5	230.8	3.05	755
6	230.2	3.76	915
7	229.2	4.52	1097
8	228.7	5.28	1275
9	228.6	6.05	1452
10	228	6.85	1665
11	227.7	7.59	1823
12	225.2	8.32	1978
13	224.5	9.08	2160

CALCULATIONS:**For Open-Circuit Test**

$W_i = V_1 I_0 \cos \theta_0,$

since, W_i , V_1 & I_0 can be obtained from the meters,the no load power factor $\cos \theta_0 = W_i / (V_1 I_0)$ can be determine,

$I_\mu = I_0 \sin \theta_0$ and $I_w = I_0 \cos \theta_0$; Hence, $X_0 = V_1 / I_\mu$ & $R_0 = V_1 / I_w$

For Short-Circuit Test

$Z_{01} = V_1 / I_{sc}$

$W_{Cu} = I_{sc}^2 \cdot R_{01}$; Hence $R_{01} = W_{Cu} / I_{sc}^2$

$X_{01} = \sqrt{(Z_{01})^2 - (R_{01})^2}$

For Load Test

OC Test

$$W_i = V_i I_o \cos \phi_o$$

$$2S_s = 230 \times 13.2 \cos \phi_o, \cos \phi_o = 0.08399$$

$$\phi_o = 85.1820$$

$$I_u = 13.2 \sin(85.1820)$$

$$= 13.1533 A$$

$$I_w = 13.2 \cos(85.1820)$$

$$= 1.1086 A$$

$$X_o = \frac{230}{13.1533} = 17.4861 \Omega$$

$$R_o = \frac{230}{1.1086} = 207.4688 \Omega$$

SC Test

$$Z_{o1} = \frac{V_i}{I_{Sc}} = \frac{22.46}{10} = 2.246 A$$

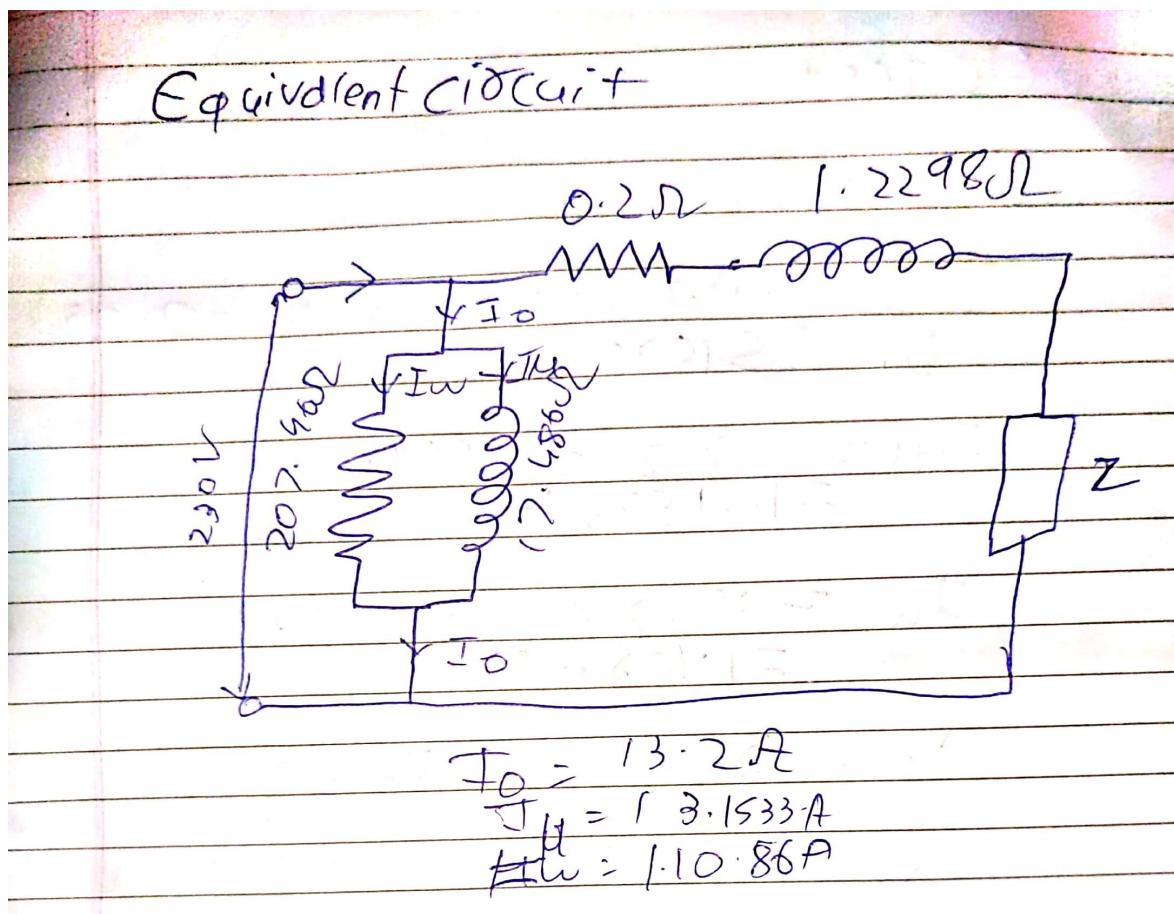
$$W_{SC} = I_{Sc}^2 R_{o1}$$

$$R_{o1} = \frac{20}{102}$$

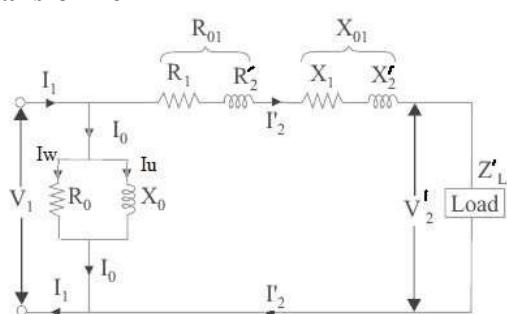
$$= 0.2 \Omega$$

$$X_{o1} = \sqrt{Z_{o1}^2 - R_{o1}^2}$$

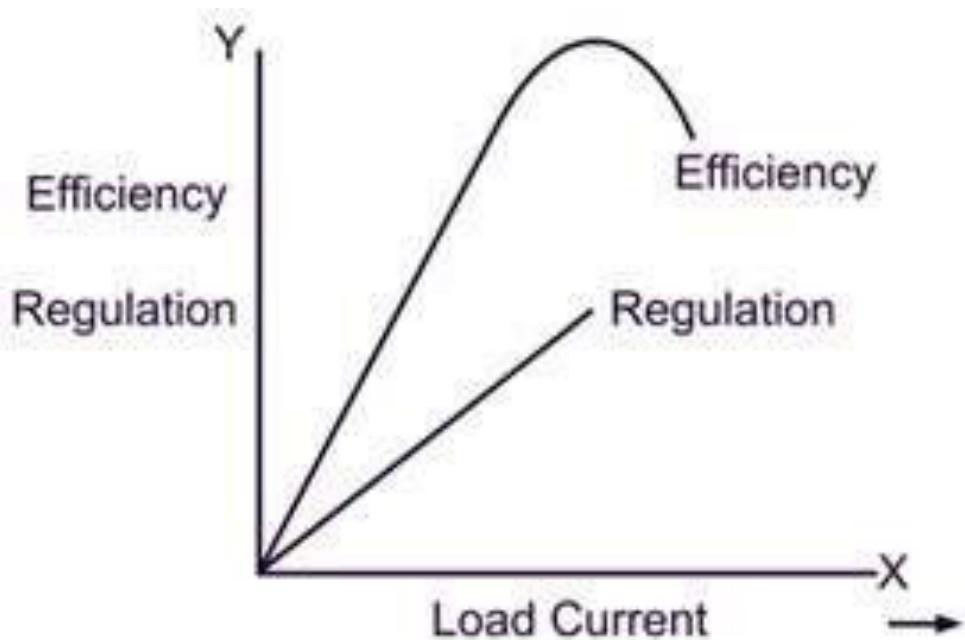
$$= \pm 2.298 \Omega$$

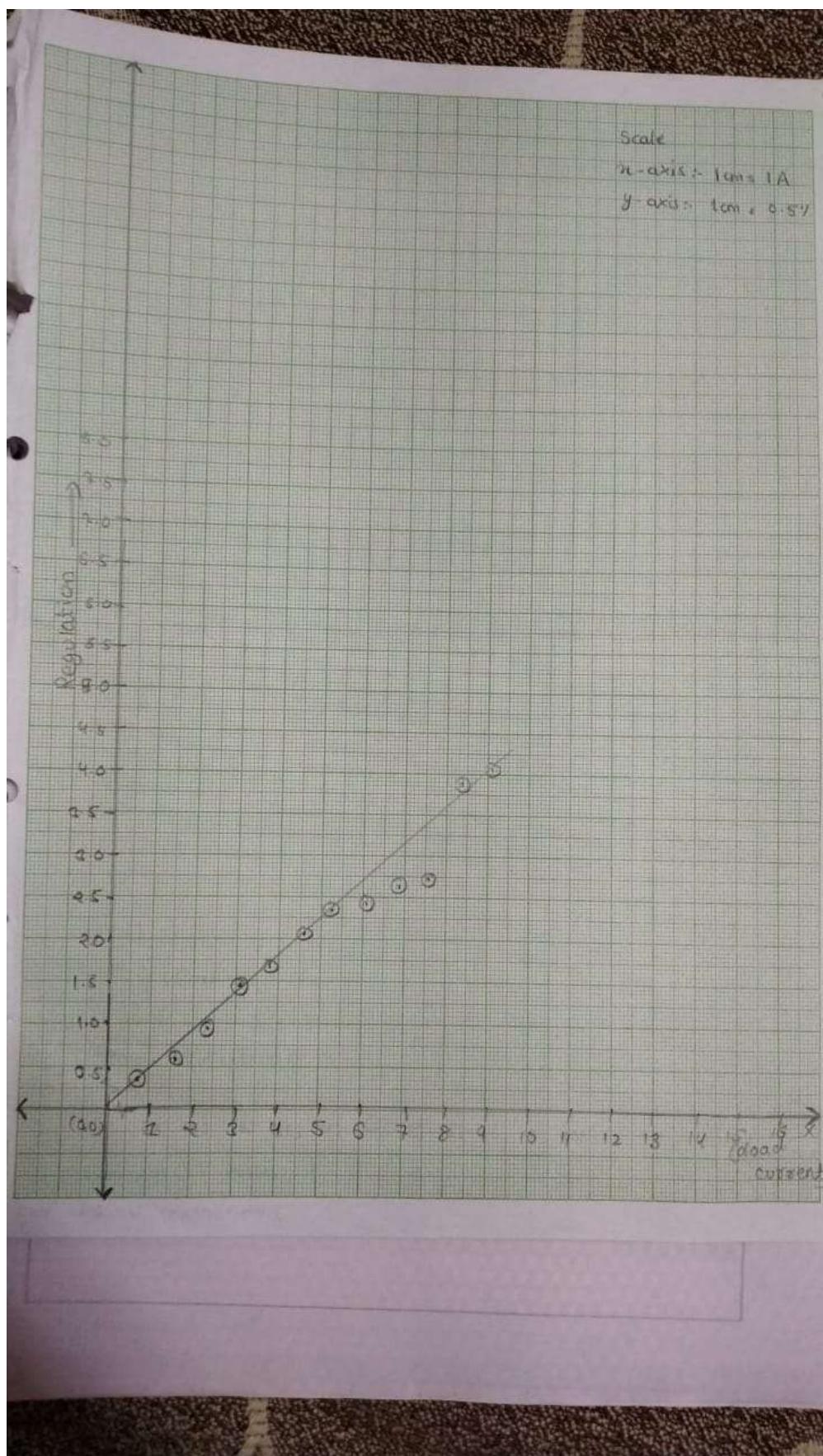
**PROCEDURE:****Load Test**

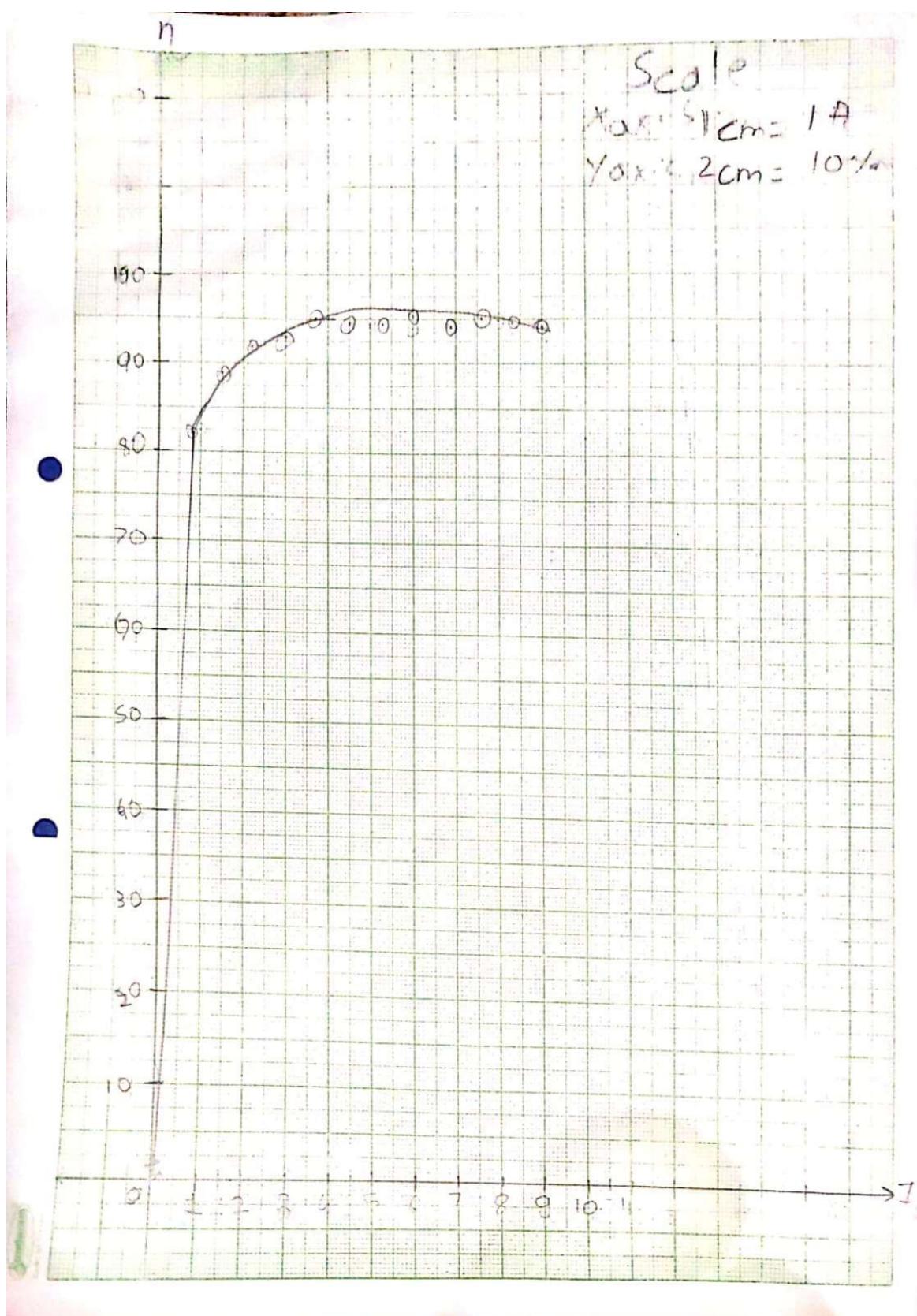
- 10) Connect the circuit as shown in the diagram.
- 11) Increase the input voltage to the transformer rated primary voltage.
- 12) Vary the lamp load in step from no load to the full load value.
- 13) Take the readings of the input wattmeter (W_1), load current (I_L) and load voltage (V_2).
- 14) Calculate efficiency and regulation.
- 15) Plot percentage efficiency and regulation v/s load current.

RESULT:**Equivalent circuit of transformer**

Sr. No	V ₂ (Volt)	I _L (Amp)	W ₁ (Watt)	% Regulation	% η
1	234.1	0	39	0	0
2	233.3	0.78	220.8	0.34	82.41
3	232.8	1.56	405	0.55	89.67
4	231.8	2.31	580	0.98	92.32
5	230.8	3.05	755	1.40	93.23
6	230.2	3.76	915	1.66	94.59
7	229.2	4.52	1097	2.09	94.43
8	228.7	5.28	1275	2.30	94.70
9	228.6	6.05	1452	2.34	95.25
10	228	6.85	1665	2.60	93.80
11	227.7	7.59	1823	2.73	94.80
12	225.2	8.32	1978	3.80	94.72
13	224.5	9.08	2160	4.1	94.37

Graph for Efficiency vs I_L and Regulation vs I_L





CONCLUSION:

By performing this experiment, we were able to understand the various tests related to transformers. We also were able to use the readings from this test to create the equivalent circuit of the transformer.