BRAC University

Department of Electrical & Electronics Engineering

Fall 2025

EEE221L - Energy Conversion 1 Laboratory

Section - 03

Group no - 03

Hardware Lab Report

Experiment - 01

Experiment : Performance Study of a Single Phase Transformer.

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Experiment - 01: Performance Study of a Single Phase Transformer

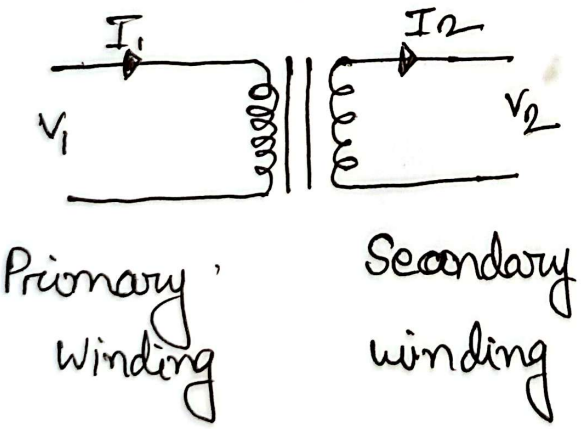
Part A:

Objective: The goal of this experiment is to study the voltage and current ratios of a transformer and learn about the 'Transformer exciting current.

Apparatus:
- Power Supply
- Transformer (Single Phase)
- Volt meter, Ammeter (AC) [2 of each]
- Resistive Loads
- Wires & Cords

Theory: Transformers are some of the most essential components that are used in almost every electrical application. The transformer is a device that transfers power from one

circuit to another circuit without changing the power by only changing voltage and current. Transformers works by using the principle of mutual magnetic induction which allows the power to be transfered without any direct electrical connection. In the AC systems transformers are crucial to transmit power efficiently by transforming low voltage high current into high voltage low current so that the losses are kept lowered. There are many types and constructions available for a transformers but the most common is



Circuit diagram:

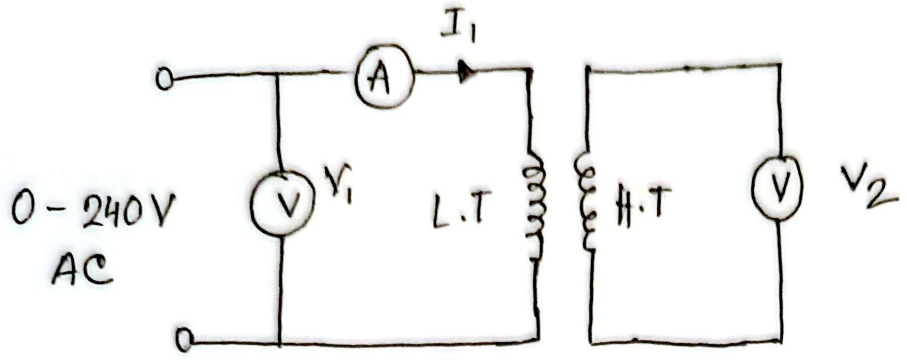


Fig-1

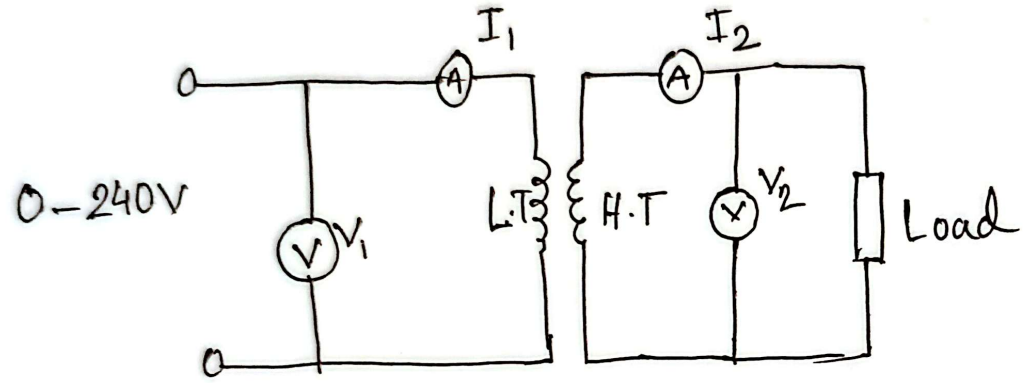


Fig-2

Procedure:

(a) Voltage Ratio:

1. Build the circuit from figure-1.
2. Turn on the power supply and gradually increase the power supply to 120V AC in the primary ~~rate~~ side (V_1) and record I_1.
3. Measure and record the secondary voltage V_2 and ~~the current~~ I
4. Return to 0V in V_1 and turn off the power.

5. Find turns ratio by formula

$$a = \frac{V_1}{V_2}$$

(b) Current Ratio:

(i) Build and connect circuit in figure-2.

(ii) Turn on the power supply and gradually increase power to 120V AC in the primary side (V_1)

(iii) Measure and record I_1 and I_2.

(iv) Turn off the power after gradually reducing power.

(v) Find turns ratio

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

Determining the Exciting Current:

The exciting current is found when there is no ~~voltage~~ load in the Secondary side.

I_1 in Circuit-1 is the Exciting Current.

Part A:

Eshan

* Data table:

Turns Ratio:

Parameters	V_1	V_2	$a = \frac{V_1}{V_2}$	I_1	I_2	$a = \frac{I_2}{I_1}$
Experimental	120 V	239. 240	1.2 0.5	0.92	0.45	0.492

Data table - 2:

Load type	load value	V_{nl}	V_{fl}	I_1 (mA)	I_2 (mA)	$\% VR = \frac{(V_{nl} - V_{fl})}{V_{fl}} \times 100$
Resistive	2000 Ω	240	236.6	300	112	1.44%
	1200 Ω	240	232.6	420	191	3.18%
	800 Ω	240	229.1	580	276	4.76%
Inductive	7.6 H	240	238.5	240	91	0.63%
	3.8 H	240	235.2	480	218	2.04%
	2.5 H	240	233.4	600	279	2.83%
Capacitive	1.5 μF	240	243	180	146	−1.23%

Results discussion:

From the experiment we can see that the input voltage from the primary side (V_1) = 120V was transformed to the secondary side by ~~having~~ $V_2 = 240$ V, which indicates that it is a step up transformer. Turns ratio for this method comes to 0.5. The current flow in primary side is 0.92 A was then transformed to 0.452 A. Turns Ratio comes to 0.492. The difference in the turns ratio from the voltage measurement and the current measurement is due to the ~~fact that~~ internal resistance in the conductors used in the windings. Also leakage flux, load etc gives different values from ideal, measuring the currents. But as the voltage measurement only differs due to frequency difference there is very negligible amount of error for the measurement.

Question answeres:

i) Voltage ratio measurement is more accurate to determining the turns ratio. As the measurement is perfomed when there is no load, the current flow losses are very very small. Also the V_2 is generated due to the emf and proportional to the winding voltage ratio gives much accurate answer.

ii) The transformers main objective is to transfer power regardless the load (reactive, resistive) which is calculated through P = Voltage × Current (VA). And as the industry uses transformer in sizes that can work in the power grid and factory etc. the practice and standard is to measure ~~the~~ and rate the transformer in KVA.

Part B:

Objective: The goal of this experiment is to learn about loading effect of transformer and also determine the voltage regulation of transformer.

Apparatus:

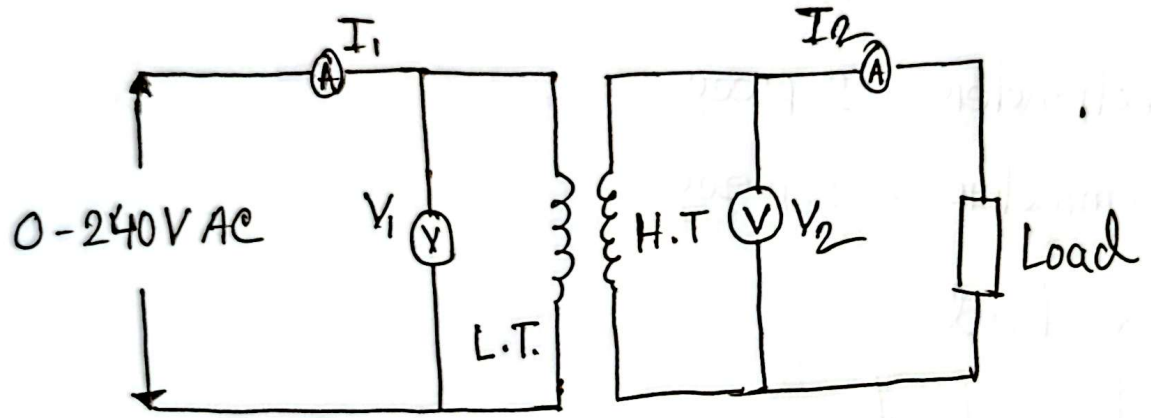
- Power Supply
- Single Phase Transformer
- AC Voltmeter - 2 piece
- AC Ammeter - 2 piece
- Resistive load
- Capacitive load
- Inductive load

Theory:

In the secondary side of a power supply when a load is connected the voltage drops. When it's in the industry level the voltage drop is very significant.

As the practical ~~loa~~ transformer has it's internal resistance and reactance the voltage drop depends on which load is connected to it. While the inductive load cause more voltage drop than a reactive load, a capacitive load might ~~show~~ cause increase in secondary voltage.

Circuit diagram:



Procedure:

1. Connect the circuit and turn on the power supply
2. Gradually increase the voltage upto 120 V
3. Gradually provide load in the transformer's secondary side.

4. Measure and record the primary voltage (V_1), primary current I_1, Secondary voltage V_2 and Secondary current I_2.

5. Return the voltage to zero and turn off the power.

6. Repeat the steps for inductive and capacitive load.

<u>Voltage regulation</u>

$$VR = \frac{V_{NL}\text{(No load)} - V_{FL}\text{(Final load)}}{V_{FL}}$$

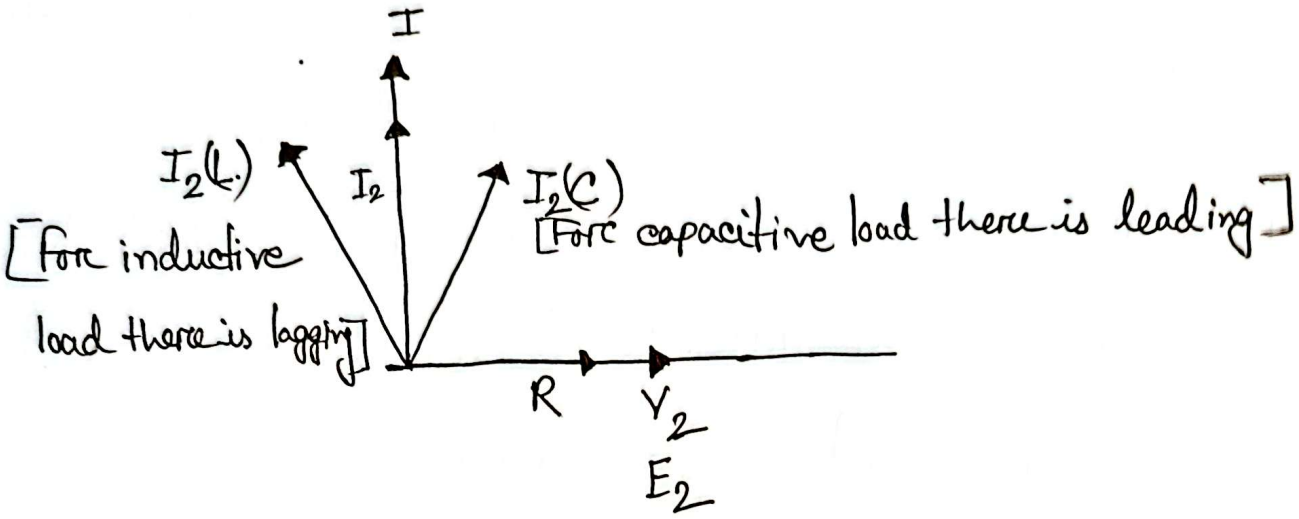
Results discussion:

From the data gathered from the experiment we can see voltage regulation ~~for~~ from the resistive load (2KΩ, 1.2KΩ, 800Ω) varied from 1.44% to 4.76% for the given loads. For the inductive load it was 0.63%, 2.04%, 2.83% for respectively 7.6H, 3.8H, 2.5H. But for the capacitive load of 1.5μF the voltage regulation was -1.23% as the with load voltage was 243 V.

Questions answers:

For the capacitive load the current is leading the load voltage instead of lagging for the resistive or inductive loads. For which the voltage drop is added with the secondary voltage terminal. Resulting a higher load voltage than no load.

Vector diagram of a real transformer:



Part A:

Eshan

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