

Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

Department of Electrical & Computer Engineering

Lab report

Course Code : ECE 1202

Course Title : Circuits & Systems-II Sessional

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Submitted To:	Submitted By:
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Experiment no.: 1

Experiment name: Study of the relation between phase voltage and line voltage in a wye connected 3 – ϕ balanced system.

Theory: In a balanced 3 – ϕ Y – Y system, if phase voltage of a phase is considered as ,

$$V_{an} = V_p \angle 0^\circ \text{ and } V_{bn} = V_p \angle -120^\circ$$

Then, line – to – line voltage between phase “a” and “b” is,

$$V_{ab} = V_{an} + V_{nb} = V_{an} - V_{bn}; \text{ which is:}$$

$$V_{ab} = \sqrt{3} V_p \angle -30^\circ$$

Now, if we consider the magnitude only, we get the relation between phase and line voltage as,

$$V_L = \sqrt{3} V_P \dots \dots \dots (1)$$

Required Apparatus:

1. AC voltage source
2. Ammeter
3. Multimeter
4. Connecting wire
5. Clamp meter

Circuit diagram:

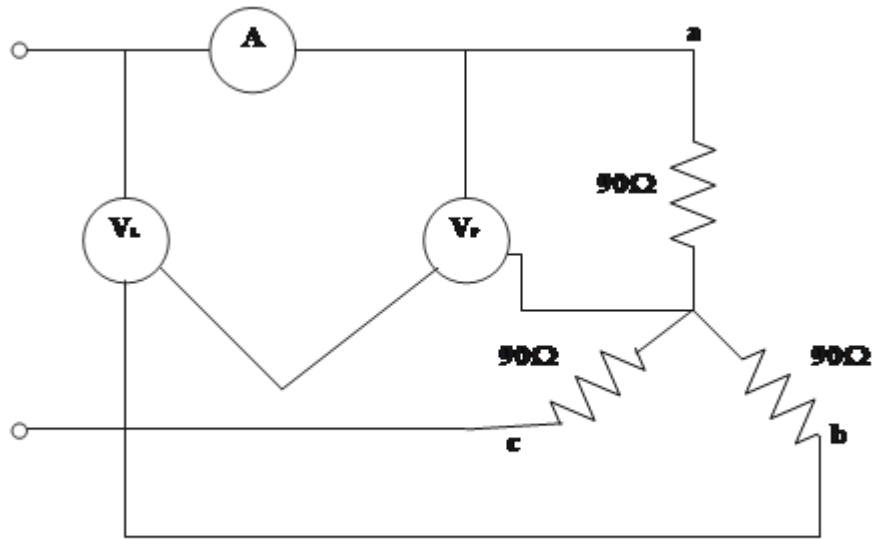


Fig. : Wye connected 3-phase balanced circuit

Calculation:

- Reading 1:**

Line voltage, $V_L = 41.7 \text{ V}$

Measured phase voltage, $V_{P(m)} = 23.5 \text{ V}$

Calculated phase voltage, $V_{P(calc)} = 24.07 \text{ V}$

$$\text{Error} = \frac{|VP(calc) - VP(m)|}{VP(calc)} \times 100\% = \frac{|24.07 - 23.5|}{24.07} \times 100\% = 2.43\%$$

- Reading 2:**

Line voltage, $V_L = 34.1 \text{ V}$

Measured phase voltage, $V_{P(m)} = 19 \text{ V}$

Calculated phase voltage, $V_{P(calc)} = 19.69 \text{ V}$

$$\text{Error} = \frac{|VP(calc) - VP(m)|}{VP(calc)} \times 100\% = \frac{|19.69 - 19|}{19.69} \times 100\% = 3.63\%$$

- Reading 3:**

Line voltage, $V_L = 55.5 \text{ V}$

Measured phase voltage, $V_{P(m)} = 31.4 \text{ V}$

Calculated phase voltage, $V_{P(calc)} = 32.04 \text{ V}$

$$\text{Error} = \frac{|VP(calc) - VP(m)|}{VP(calc)} \times 100\% = \frac{|32.04 - 31.4|}{32.04} \times 100\% = 2.05\%$$

- Reading 4:**

Line voltage, $V_L = 63.6 \text{ V}$

Measured phase voltage, $V_{P(m)} = 35.6 \text{ V}$

Calculated phase voltage, $V_{P(calc)} = 36.72 \text{ V}$

$$\text{Error} = \frac{|VP(\text{calc}) - VP(m)|}{VP(\text{calc})} \times 100\% = \frac{|36.72 - 35.6|}{36.72} \times 100\% = 3.41\%$$

• **Reading 5:**

Line voltage, $V_L = 71.7 \text{ V}$

Measured phase voltage, $V_{P(m)} = 40.5 \text{ V}$

Calculated phase voltage, $V_{P(calc)} = 41.4 \text{ V}$

$$\text{Error} = \frac{|VP(\text{calc}) - VP(m)|}{VP(\text{calc})} \times 100\% = \frac{|41.4 - 40.5|}{41.4} \times 100\% = 2.21\%$$

$$\therefore \text{Average error} = \frac{2.43 + 3.63 + 2.05 + 3.41 + 2.21}{5} = 2.746\%$$

Table for Studying Relation Between Line and Phase Voltage:

Serial No	Line Voltage, V_L (V)	Measured Phase Voltage, $V_{P(m)}$ (V)	Calculated Phase Voltage, $V_{P(calc)}$ (V)	Percentage of Error (%)	Line Current, I_L (A)	Phase Current, I_P (A)
1	41.47	23.5	24.07	2.43	0.24	0.24
2	34.1	19	19.69	3.63	0.21	0.21
3	55.5	31.4	32.04	2.05	0.358	0.35
4	63.6	35.6	36.72	3.14	0.407	0.4
5	71.7	40.5	41.4	2.21	0.462	0.46

Result: Average percentage of error was 2.746%

Discussion: Through the experiment, we proved the relation between phase and line voltage in a 3 – ϕ balanced Y – Y system. After all the calculations, we figured our error margin was 2.746% which is negligible. This little error margin certifies that, the line voltage is $\sqrt{3}$ times that of phase voltage.

Reference:

Fundamentals of Electric Circuits by Charles K. Alexander and Mathew N. O. Sadiku.