Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

Department of Electrical & Computer Engineering

Lab Report

Experiment No: 01

Name of the experiment:

Study the relationship between phase voltage and line voltage of wye connected 3 phase balanced system.

Course Code	ECE 1202
Course Title	Circuits & Systems-II Sessional
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Experiment No. 01

Name of the Experiment: Study the relationship between phase voltage and line voltage of wye connected 3 phase balanced system.

Objective: To verify the relationship between phase voltage and line voltage in a balanced three-phase system connected in a wye (Y) configuration.

Theory:

In a balanced three-phase system, the voltages are symmetrical and have equal magnitudes, separated by 120° phase angles. For a wye-connected system:

- **Phase Voltage (V_P)**: The voltage measured between any one line and the neutral point.
- **Line Voltage (V_L)**: The voltage measured between any two lines.

The relationship between the line voltage and phase voltage in a wye-connected system is given by: $V_L = \sqrt{3}\, V_P \quad , I_L = I_P$

Required Apparatus:

1. Voltmeter
2. Ammeter
3. Multimeter
4. Source
5. Connecting Wires

Circuit Diagram:

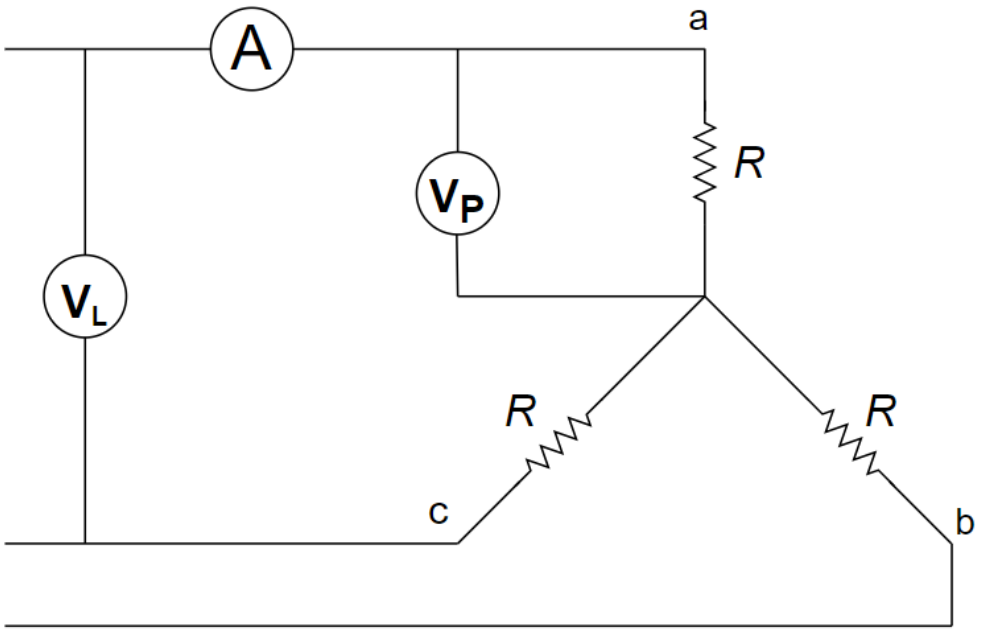
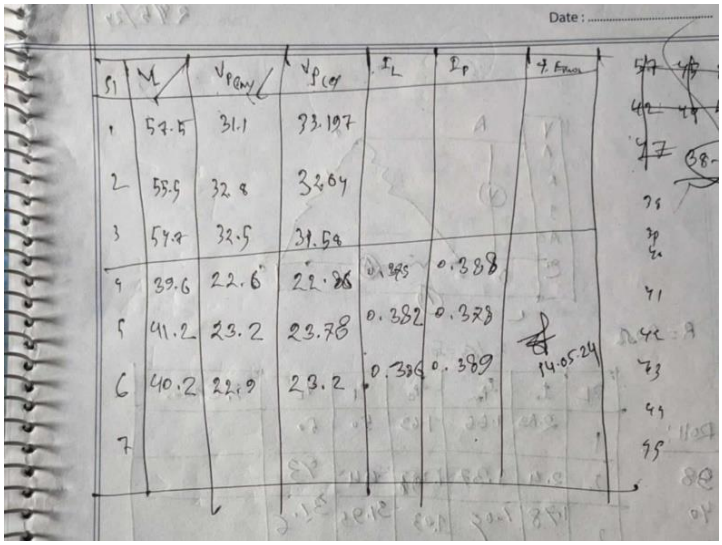


Fig 1.1 *wye-connected three-phase system*

Data Table:

Sl.	V_L	$V_{P\,(m)}$	$V_{P\,(c)}$	I_L	I_P	Error, $\mathbf{e} = \left\lvert \frac{V_{P(c)} - V_{P(m)}}{V_{P(c)}} \right\rvert \times 100\%$
1	39.6	22.6	22.86	0.375	0.388	1.14%
2	41.2	23.2	22.78	0.382	0.378	2.44%
3	40.2	22.9	23.20	0.386	0.389	1.29%

Data Table from Lab experiment:



Calculations & Results:

In wye connection, $V_L = \sqrt{3}\, V_P \;\Rightarrow\; V_P = \frac{V_L}{\sqrt{3}}$

For trial 1,

$V_{P(c)} = \frac{V_L}{\sqrt{3}} = \frac{39.6}{\sqrt{3}} = 22.86\, V$

$\text{error} = \left\lvert \frac{V_{P(c)} - V_{P(m)}}{V_{P(c)}} \right\rvert \times 100\% = \left\lvert \frac{22.86 - 22.6}{22.86} \right\rvert \times 100\% = 1.14\%$

For trial 2,

$V_{P(c)} = \frac{V_L}{\sqrt{3}} = \frac{41.2}{\sqrt{3}} = 22.78\, V$

$\text{error} = \left\lvert \frac{V_{P(c)} - V_{P(m)}}{V_{P(c)}} \right\rvert \times 100\% = \left\lvert \frac{22.78 - 23.2}{22.78} \right\rvert \times 100\% = 2.44\%$

For trial 3,

$V_{P(c)} = \frac{V_L}{\sqrt{3}} = \frac{40.2}{\sqrt{3}} = 23.20\ V$

error $= \left|\frac{V_{P(c)} - V_{P(m)}}{V_{P(c)}}\right| \times 100\% = \left|\frac{23.30 - 22.9}{23.30}\right| \times 100\% = 1.29\%$

Average error $= \frac{1.14 + 2.44 + 1.29}{3} = 1.62\%$

There are slight errors in the measurement of phase voltages due to factors such as instrument precision, connection stability, or minor variations in the load.

Discussion:

This experiment confirmed the theoretical relationship between phase and line voltages in a Wye-connected three-phase balanced system, where the line voltage was √3 times the phase voltage. This relationship is crucial for the analysis and design of balanced three-phase power systems.

Precautions:

1. All connections were securely fastened and insulated to prevent short circuits or electric shocks.
2. High accuracy and minimal errors were ensured by using properly calibrated instruments.

Reference:

1. Alexander, Charles K. and Matthew N. O. Sadiku, Fundamentals of Electric Circuits:

   a. Chapter 12

2. Wikipedia