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.: 02

Experiment name: Study the relationship between phase current & line current of a delta connected 3-phase balanced system.

Theory: In a balanced 3 – ϕ Y - Δ system, phase currents are:

$$\mathbf{I_{ab}} = \frac{\boldsymbol{V_{ab}}}{\boldsymbol{Z_{\Delta}}}, \mathbf{I_{bc}} = \frac{\boldsymbol{V_{bc}}}{\boldsymbol{Z_{\Delta}}} \text{ and } \mathbf{I_{ca}} = \frac{\boldsymbol{V_{ca}}}{\boldsymbol{Z_{\Delta}}}$$

The line currents can be obtained from applying KCL. So, the line currents will be:

$$\mathbf{I_A = I_{ab} - I_{ca}}\text{ , }\mathbf{I_B = I_{bc} - I_{ab}} \text{ and } \mathbf{I_C = I_{ca} - I_{bc}}$$

Since, $\mathbf{I_{CA} = I_{AB}\angle -240^{\circ}}$,

$$\mathbf{I_A = I_{ab} - I_{ca} = I_{ab}\,(1 - 1\angle -240^{\circ}) = I_{ab}\,(1 + 0.5 - j0.866) = I_{ab}\sqrt{3}\angle 30^{\circ}}$$

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

$$\mathbf{I_P = \frac{I_L}{\sqrt{3}} \ldots \ldots \ldots (1)}$$

Required Apparatus:

1. Source
2. VARIAC
3. Voltmeter
4. Ammeter
5. Resistor
6. Multimeter
7. Connecting wires

Circuit diagram:

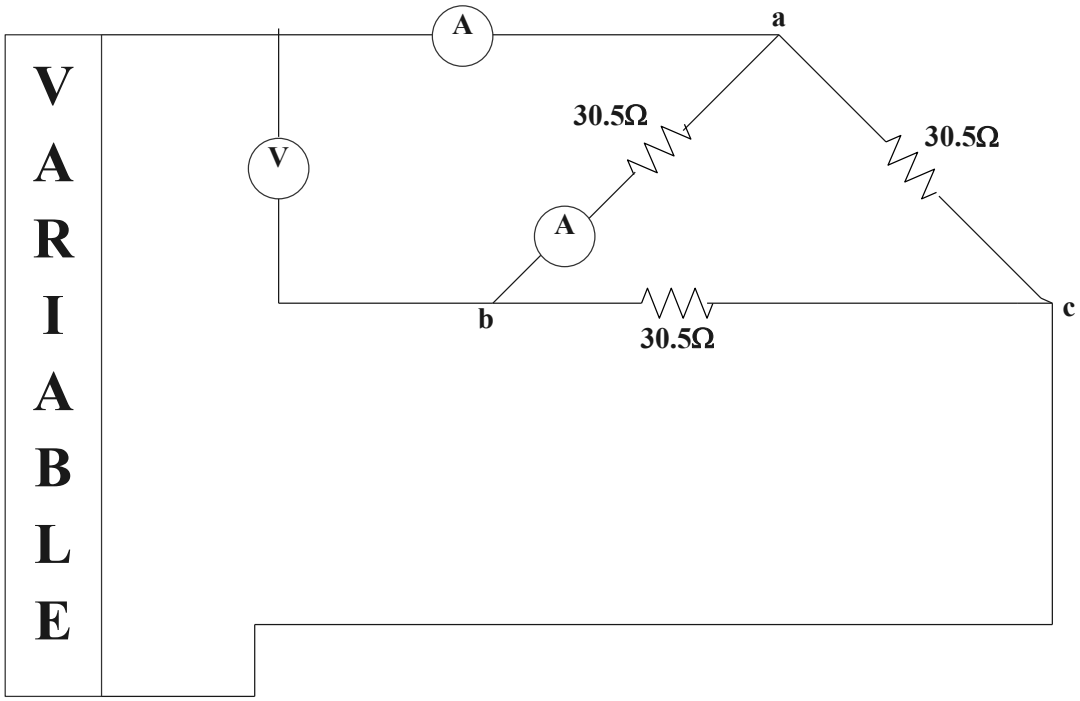

Fig. : Delta connected 3-phase balanced circuit

Calculation:

- **Reading 1:**

  Line current, I_L = 2.25 A

  Measured phase current, $I_{P(m)}$ = 1.26 A

  Calculated phase current, $I_{P(calc)}$ = 1.29 A

  Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)} \times 100\% = \frac{|1.29 - 1.26|}{1.29} \times 100\% = 2.32\%$

- **Reading 2:**

  Line current, I_L = 0.72 A

  Measured phase current, $I_{P(m)}$ = 0.39 A

  Calculated phase current, $I_{P(calc)}$ = 0.41 A

  Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)} \times 100\% = \frac{|0.41 - 0.39|}{0.41} \times 100\% = 4.87\%$

- **Reading 3:**

  Line current, I_L = 1.28 A

  Measured phase current, $I_{P(m)}$ = 0.7 A

Calculated phase current, $I_{P(calc)}$ = 0.74 A

Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)} \times 100\% = \frac{|0.74 - 0.7|}{0.74} \times 100\% = 5.4\%$

- **Reading 4:**

  Line current, I_L = 1.87 A

  Measured phase current, $I_{P(m)}$ = 1.04 A

  Calculated phase current, $I_{P(calc)}$ = 1.08 A

  Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)} \times 100\% = \frac{|1.08 - 1.04|}{1.08} \times 100\% = 3.7\%$

- **Reading 5:**

  Line current, I_L = 2.79 A

  Measured phase current, $I_{P(m)}$ = 1.59 A

  Calculated phase current, $I_{P(calc)}$ = 1.61 A

  Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)} \times 100\% = \frac{|1.61 - 1.59|}{1.61} \times 100\% = 1.24\%$

∴ Average error = $\frac{2.32+4.87+5.4+3.7+1.24}{5}$ = 3.506%

Table for Studying Relation Between Line and Phase Voltage:

Serial No	Line Current, I_L (A)	Measured Phase Current, $I_{P(m)}$ (A)	Calculated Phase Current, $I_{P(calc)}$ (A)	Percentage of Error (%)	Line Voltage, V_L (V)	Phase Voltage, V_P (V)
1	41.47	23.5	24.07	2.32	39.0	38.3
2	34.1	19	19.69	4.87	12.84	12.83
3	55.5	31.4	32.04	5.4	22.15	21.83
4	63.6	35.6	36.72	3.7	32.17	31.6
5	71.7	40.5	41.4	1.24	47.3	47.1

Result: Average percentage of error was 3.506%

Discussion: Through the experiment, we proved the relation between phase and line current in a $3 - \phi$ balanced $Y - \Delta$ system. After all the calculations, we figured our error margin was 3.506% which is negligible. This little error margin certifies that, the line current is $\sqrt{3}$ times that of phase current.

Reference:

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